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DERMOID AND OTHER CYSTS OF THE OVARY

THEIR ORIGIN FROM THE WOLFFIAN BODY

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SAMUEL W. BANDLER, M.D.

New York

(With 105 illustrations)

[Reprinted from The American Journal of Obstetrics, Vol. XLIII, 1901]

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DERMOID AND OTHER CYSTS OF THE OVARY:

THEIR ORIGIN FROM THE WOLFFIAN BODY.

DERMOID cysts occur in various parts of the body. A favorite place is the region of the head—on the outer upper part of the orbit, on the bulbus, on the temporal bone, in the neighborhood of the processus mastoideus and the large fontanelle. These are congenital, grow slowly, and are observed as a rule at or after puberty. They originate from displaced epidermis—*i.e.*, skin cells (Tillmanns).

According to Mikulicz,[1] the origin of dermoids in the upper external region of the eye stands in close relation to the infolding of the ectodermal corneal layer in the formation of the lens; those of the glabella stand in relation to the development of the olfactory grooves, or to the union of the frontal bone with the superior maxilla; those near the large fontanelle and in the occipital region are the result of processes concerned in the development of the brain. According to Poirier, Entor, and others, the retroauricular dermoids stand in embryological relation to the union of the two parts forming the processus mastoideus—*i.e.*, the mastoid portion and the petrous portion. These dermoids are cysts whose inner wall, like the skin, consists of epidermis, corium, sebaceous glands, hair follicles, and sweat glands. The contents are composed of a fatty white or yellow, greasy mass containing hair and often cartilage and bone. These are composed, therefore, not alone of ectodermal but also of mesodermal tissues.

[1] Wiener med. Wochenschrift, 1876, Nos. 39–44.

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Dermoids are found likewise in the cranial cavity between the occipital bone and the dura. For unknown reasons epidermis cells make their way into the mesoderm. Calcification occurs several weeks after the union of the soft primary skull. Meanwhile the mesoderm has increased greatly in thickness, and on its inner surface the meninges, including the dura, have become differentiated. In this way, after ossification of the mesoderm, the resulting bone lies upon those ectoderm cells dating from the earliest embryological period, and the subsequent products of these cells lie between the dura and the bone. These ectoderm cells can likewise find their way to the base of the fourth ventricle and give rise to dermoids in that region (Kollmann).

Dermoid cysts are also found at the root of the tongue, originating from the so-called ductus excretorius linguæ or from fistulæ of the branchial clefts.

Dermoids appear likewise in the orbit behind the eye, those upon the bulbus being naturally visible on examination. The dermoid cysts of the orbit are observed rather frequently. Graefe found, among 73 cases, 39 which, without doubt, may be characterized as real dermoid cysts because of their contents, in that 1 contained a tooth, 2 contained calcium concrements, 6 hair, 19 epithelial—*i.e.*, epidermal—cells, fat in fluid form or as fat crystals or as a tenacious, honeylike mass. Of these, 38 per cent were congenital and 35 per cent were observed between the ages of 9 and 19 years. Graefe explains these as fetal products resulting from an infolding of the external embryonal layer. Weigert described a case containing cartilage, bone, glandular structures, and "intestine-like tubes," likewise epidermis cells.

The median line of the palate may also be the seat of dermoid growths.

Cartilage appears sometimes in the region of the middle and the lowest branchial arch, and originates from the growth of displaced cartilage cells. The deeply-situated epithelial carcinomata of the neck result from detached epithelial cells, especially from the fetal branchial arches, from detached thyroid lobes, or from displaced skin cells—*i.e.*, dermoids.

In the neck are found branchial cleft dermoids which, according to Schnitzler, are formed by an inversion of the epidermis in the region of the branchial folds. The inner surface has the structure of skin; the contents consist of epidermal cells and hair, sometimes also of bone, cartilage, and *teeth*.

Although rare, dermoids of the esophagus occur.

Dermoid cysts are found, further, near and behind the sternum. From the mediastinum these may grow into the lung. Büchner observed a dermoid cyst of the lung the size of a child's head; it communicated with the aorta. Dermoids of the mediastinum are indeed, as a rule, tumors which originate from such epithelial remains of the branchial cleft as descend into the anterior chest space during the further development of the thymus gland, itself a derivative of the branchial structures (Pflanz).

Harres published a case of a dermoid situated between the heart and the left lung; in its wall cartilage and bone were found.

Gordon found under the sternal end of the left clavicle a cyst filled with hair and cheesy matter; the cyst contained a bone resembling the superior maxilla, in which were seven *teeth* more or less firmly embedded. According to Wilms, Marchand found a cyst in the anterior upper mediastinum whose wall was partially calcified. This cyst contained cartilage, bone, cutis, and ciliated epithelium.

Wilms accepts for these cases the same explanation, as to their origin, which Pflanz put forth.

The cholesteatomata of the mamma are considered to be sometimes atheromata, sometimes dermoid cysts. The deeper subcutaneously situated atheromata result from detached embryonal cells containing sebaceous glands, or else they are real dermoids.

According to Gussenbauer, fistulæ and cysts containing skin and hair are not infrequently found in the sacral region, mostly in adults. They may be simple cysts, or multilocular, which, however, as a rule show no communication. These dermoids are found either exactly in the median line or very near it, in the region of the three last sacral vertebræ or near the coccyx. Although they are the result of an irregular embryonal process—*i.e.*, a fetal inclusion of ectoderm—yet they do not manifest themselves at birth and rarely during childhood or puberty. In most cases they come under observation after the completion of body growth. The tumor, as a rule, reaches no decided dimensions, and for that reason escapes observation so long as no inflammatory symptoms arise; yet cases occur where the tumor becomes noticeable because of its size. Then they may be easily recognized as cysts with thick, cheesy contents. These cysts are rarely connected with the bone.

In the sacral region, according to Tillmanns, are found cystic formations containing cartilage, bone, "rudimentary intestine," brain tissue, nerves, muscle, glandular structures, etc. Although he considers some of these to be "parasitical double formations," "fetus in fetu," Tillmanns acknowledges that in other cases the various tissue forms found in the tumor are to be considered as resulting from detached cells, "inclusio fetalis." The congenital tumors in the sacral region have been divided by Nasse and Von Bergmann into (1) simple dermoids, (2) complicated dermoids, (3) teratomata, (4) cystosarcomata. These lie ventral or dorsal to the coccyx. The dorsal cysts of the sacro-coccygeal region, according to Mallory, are analogous to the malformations found in the branchial clefts. The ventral cysts, as we shall see later, are connected with changes in the caudal diverticulum, an embryonal rest of the intestine. Kümmel found in a congenital tumor in the sacral region a structure resembling the eye, which will be considered further on.

From this short review it may be seen that at the various points of union on the head, face, neck, mediastinum, spine, spinal cord, etc., as well as at all the other fetal furrows, clefts, and points of union, where, through disturbances of normal development, congenital malformations, fistulæ, and deformities may occur, also dermoid cysts may be found. These latter result through an infolding or detachment of cells often prominently ectodermal, but usually ectodermal and mesodermal. The cells may grow and develop (1) near their place of origin, or (2) far from their source of development, namely, dermoids between the skull and the dura, or mediastinal dermoids (theory of Pflanz). The displaced cells form the same tissues which they would have produced had they not been detached from their normal location, cause likewise large tumors, and yet the normal development of the individual may be in nowise disturbed, or it may undergo various changes. It has been stated by many that such tumors, often very large, could not originate from displaced cells, for then the normal development would suffer by the loss of these cells and by the interference due to their presence. If, however, we consider that a fetus is developed in nine months from practically one cell, that from epithelial cells immense carcinomata result, and that in the ovary cyst-adenomata of immense size develop in a short time, we may then understand that not many cells removed from trophic control are needed to furnish eventually large growths.

In the above-mentioned regions appear highly complicated dermoids, for which the most diverse theories, without actual foundation, have been evolved; for instance, "double formation with subsequent union," "parasitical double formation," "fetus in fetu," "inclusio fetalis," etc. Nothing in pathology has created greater confusion than these various ideas, and it is only through an embryological study of the real mode of development of these dermoids that we can show the falsity of these theories. That double formations occur is not to be denied, since the medullary plates are capable each of producing an entity, and double formations are not rare events among fishes, etc.; but we need a sharp line of demarcation between these occurrences and those cases so generally explained as teratomata, double formations, and fetus in fetu.

I therefore quote a few complicated cases which illustrate these errors. Breslau and Rindfleisch described a fetus out of whose mouth there protruded a most easily movable tumor, the size of a man's fist, and attached to a pedicle (Fig. 1):

> "The fetus showed relatively slight development of the cranial bones, wide sutures and fontanelles pointing to hydrocephalus. The brain was so soft that scarcely the crudest relations could be made out. The round pedicle of the tumor, measuring at the oral opening four lines in diameter, becomes thinner toward its base, so that in the region of the velum palatinum it measures only two lines. The uvula is attached to it from above. The serous covering of the pedicle takes on gradually the character of mucous membrane and goes on into the mucous covering of the posterior pharynx. The substance of the pedicle itself continues on to the basis cranii. We shall see directly how this pedicle passes through the base of the skull, and in this way furnishes the union of the external tumor with a second intracranial one."
>
> "The intracranial tumor lay upon the floor or base of the skull, fastened by a band in the sella turcica. After removal of the operculum ephippii I convinced myself that the pituitary body failed entirely; the pedicle of this tumor disappeared, however, in a round hole in the floor of the sella (Fig. 3). The body of the sphenoid was entirely perforated; I have

shown this spot from above in Fig. 3 with the dura mater removed. It may be observed that the ossification at this point is quite incomplete. Through this hole in the base of the sella the pedicles of the external and intracranial tumors connect with each other. A close examination of the inner tumor showed the presence in various parts of irregular horseshoe-shaped structures. These were broadened at their point to a three-cornered surface, and showed on the free edge of this surface a clear digitation, so that they reminded one immediately of deformed extremities. At one point four were observed, and as I studied more closely I obtained the view which I have given in Fig. 2. *Two black spots are the eyes; a transverse depression under these is the mouth; a number of communicating circles, which further down show through the thin covering, are the intestines; and the four prominences are the four extremities of a decidedly poorly developed fetus.* An umbilical cord is also present; the same runs from the highest point above the intestines toward the left, where it goes over into the thin covering of the tumor. This cover, then, must be considered to be the amnion, even though no other grounds for this supposition were found. It is therefore a fetus in fetu in the closest sense of the word—a fetus not content to be taken up under the skin of its autosite, but one *which has made its way into the skull of the other* (!). What, however, is of still greater interest and of greatest importance

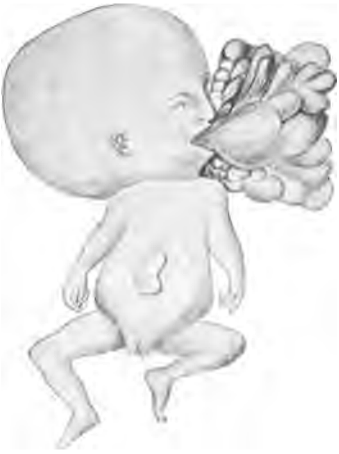


FIG. 1.

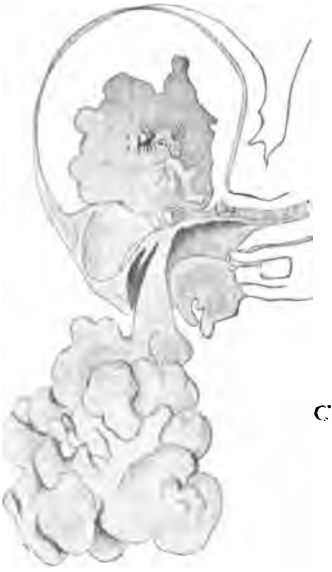


FIG. 2.

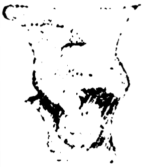


FIG. 3.

for a proper appreciation of this entire group is the presence of still more extremities; I count seven of them. Eyes are present at various points, so that there is no doubt that we must speak here of, not one, but of several fetus in fetu—*i.e.*, of a quite lawless and rich production of entire body organs. There is no doubt that this production goes out from the hypophysis —*i.e.*, that it was implanted on destruction of the hypophysis and in its place. Before I go on to further discussion of this condition, let us review the histological state of the remaining tumor mass. Cartilage, bone, muscle, nerves. and glandular substance are here present in a wonderful arabesque arrangement, embedded in fetal connective tissue. Here is a twisted horseshoe-shaped fragment of cartilage, there in the small depressions are found mucous glands without outlet; in another place is seen a muscle band passing through a piece of cartilage and turning again in a circle upon itself; in a third place are Malphigian capsules with kidney tubules grouped in the form of rosettes; certain large, dark-red masses consist mainly of coagulated blood, but one finds in them muscle and nerve fibres undergoing molecular degeneration—in short, it is, all in all, a histological potpourri. The epithelium of the oral cavity goes on as a squamous, non-stratified epithelium into the thin covering of the tumor protruding from the mouth."

Beck quotes, in the *Zeitschrift für Heilkunde,* Bd. iv., 1883, many most interesting cases of this sort. He describes the following condition found by himself in a 74-year-old woman:

"In the sella turcica was found a tumor the size of a walnut, which formed a prominence toward the cranial cavity, widened the sella turcica, and compressed greatly the chiasma nervorum opticorum lying above it. No part of the pituitary body was to be found. The tumor had a clearly alveolar form, showing in addition many spaces. These cavities contain partly a white, brittle, coagulated, mucus-like mass, partly more compact structures like cartilage. Other cavities were filled with a spongy, bone-like tissue; still others contained compact yellow masses, hard as bone, having the appearance of teeth. Their size varied from that of a pea to that of a kernel of maize; their number was large. From both surfaces of a median sagittal incision protruded fourteen *teeth.* The individual teeth, most of them of the form of bicuspidati, showed a white, shining, enamelled surface and a yellow, rough cement one."

There follows a histological description of the tumor furnishing most interesting conditions. Beck continues then as follows:

"If, on the one hand, we are to classify this tumor from the anatomical and histological evidences, and, on the other hand, if we are to bring forward an explanation of its origin, then in the first place, according to the now existing views, there can be no objection to considering as a teratoid growth depending upon fetal malformation this tumor in the sella turcica, containing as it does cysts with colloid contents. *teeth,* bone, and cavities lined with ciliated epithelium. To explain the origin of this teratoma several possibilities must be taken into consideration. In the first place, we may think of an inclusio fetus in fetu—*i.e.*, an entirely individual twin, restrained in its development and enclosed in the skull of its autosite; or we may be dealing with a parasite form of partial embryonal cell division, a duplicitas anterior or posterior; finally, however, this growth may be considered as having originated from displaced cells of the fetus or of the hypophysis itself. An inclusio fetus, the enclosing of a fetus fully separated from the other in the sella turcica of the other, may be explained in two ways. The first view is that which Ahlfeld accepts in the case of epignathi, of teratoma in the sella turcica, and of teratoma of the cranial cavity inside of the dura mater. Two fetuses lie head against head very close to each other, on one blastula. If the one in a very early embryonal period, for some reason, is retarded in his development, he will gradually come nearer to the other growing fetus. At first situated near the anterior part of the amnion of the growing embryo, it soon reaches the anterior turning point of the head of the same, and, going along the turning point of the amnion, *comes into the neighborhood of the oral cavity, and then goes into the sella turcica, and even further into the brain, over the same road which the so-called hypophysis sac takes,* this sac, a protrusion of the ectoderm, being the structure from which the hypophysis develops. In this way, according to Ahlfeld, all epignathi may be explained: those situated anteriorly in the palate, those on the neck, even those attached to the sella turcica and those furnishing the largest number of brain teratomata. The second path which a fetus situated in the sella turcica of a second fetus may take is not that through the mouth, but through *the cephalic end of the medullary canal,* which Kölliker says remains open for a relatively long period (!). The fetus makes its way then to the seat of the pituitary body, so that it finally lies in the infundibulum, an outgrowth of the hypophysis. It is of advantage, in deciding which of the above-mentioned modes of origin will explain the presence of the tumor in question, to compare the same with other teratomata in the sella turcica. It must be stated that the other teratomata contained complicated but genuine fetal organs, and that in addition other malformations were present, such as cleft palate, persistence of the sphenoidal canal, and disturbances in the development of the base of the skull and of the brain, none of which failures are present in our case. The structure of this tumor is relatively uncomplicated; it lies almost entirely in the sella turcica. No other malformations were seen in the patient. These facts speak against a fetal inclusion or partial parasitical cell division, and the structure of the tumor makes another explanation more probable. As we see that in our case the epithelium as well as the connective tissue has taken on an abnormal character in its growth, in that they have produced teeth and real bone, it is natural to believe that a part of the anterior lobe of the hypophysis, after its detachment from the pharynx, has preserved its ability, for some reason, to form teeth and bone. It must be mentioned here that that part of the oral mucous membrane from which the hypophysis is developed lies near the future seat of development of the posterior teeth of the upper jaw. Even the presence of ciliated epithelium in this tumor is not strange, since Peremeschko has shown that the canal which forms the hypophysis possesses *de norma* ciliated cylindrical epithelium. At any rate, the fact that in this case in various parts of the tumor pituitary tissue is present shows that the hypophysis has undergone teratoid growth only partially. At least there is the greatest probability that this teratoma is truly a teratoma of the hypophysis cerebri."

That Beck touched closely upon the correct explanation in his case may be seen from the following embryological review. It is also clear that this explanation covers all the cases quoted and discussed by him, as well as the case of Breslau and Rindfleisch. It would be remarkable to consider the tumor described by Beck the result of a displacement of cells, and yet view the other cases, even if they communicate with a palatal growth through the hypophysis canal, epignathi according to Ahlfeld, since in both classes the same tissue formations are present. It will be scarcely necessary to discuss further the fantasy of the theories of Ahlfeld and others. It is rather remarkable, at any rate, that such views could really have been accepted seriously—the idea that a fetus could make its way into the brain through a canal in the sella turcica or through the cranium to the base of the skull. At the same time we recognize the force of imagination which influenced those authors, for whom the idea of a fetus in fetu possessed a certain reality, to describe eyes, mouth, extremities, intestine, etc., as components of these growths.

The following illustration follows that given by Hertwig. To appreciate the beginning of the formation which results in the hypophysis, we may see in Fig. 4 that the oral cavity (*hp*) is separated from the cephalic portion of the primary alimentary canal (*kd*) by the pharyngeal membrane (*rh*). At the

upper end of the chorda dorsalis (*ch*) is the spot (*hp*) where a part of the pituitary body, a product of ectoderm, begins its development.

A small inversion of epithelium takes place which extends gradually toward the base of the cranium (*tr*, Fig. 5). This is the pocket of Rathke, or the hypophysis sac (*hy*, Fig. 5). This pocket deepens, begins to separate itself from its source of origin (ectoderm), and finally forms a cavity whose wall consists of several layers of cylindrical epithelium (Fig. 6, *hy*).

The hypophysis sac (*hy*) remains for a certain time connected with the oral cavity through a narrow canal (*hyg*, Fig. 6).

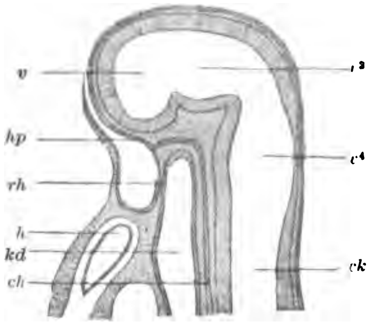


FIG. 4.

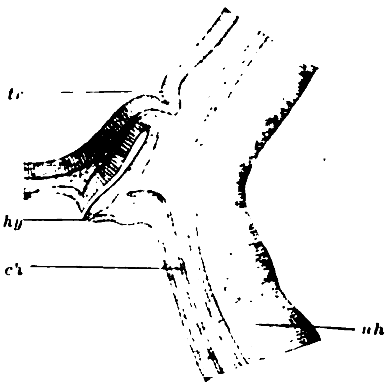


FIG. 5.

FIG. 4.—Median section through the head of a 6-millimetre-long rabbit embryo. After Mihalkovics. *rh*, pharyngeal membrane; *hp*, spot from which the hypophysis develops; *kd*, primary alimentary canal; *ch*, chorda dorsalis; *v*, v^4, brain ventricles; *ck*, central canal of the spinal cord.

FIG. 5.—Median sagittal section through the hypophysis of a 12-millimetre-long rabbit embryo. After Mihalkovics. Enlarged 50 ×. *tr*, base of the subsequent processus pinealis; *hy*, hypophysis sac, or pocket of Rathke.

At a later stage this connection ceases. The embryonal connective tissue (*schb*, Fig. 6) which furnishes the substance for the development of the cranial bones increases in thickness, and separates the sac still further from its source of origin (Figs. 6 and 7).

When finally in this connective tissue the development of cartilage takes place which eventually furnishes the cartilaginous base of the skull, this hypophysis sac (*hy*) lies above this base and on the under surface of the other lobe of the pituitary body (*tr*, Fig. 6). At this time also the hypophysis canal (*hyg*) has lost its lumen, shrinks, and begins to disappear

(Fig. 7). In many vertebrates this canal remains, and, passing through the cartilaginous base of the skull, communicates with the mucous membrane of the mouth.

Therefore we may see how ectodermal and mesodermal cells, displaced in the formation of the hypophysis canal and of the hypophysis, and likewise cells of the hypophysis itself, may, by independent growth, produce tumors which may lie in the sella turcica alone or may communicate through the hypophysis duct with a like tumor of the palate or oral cavity.

Kollmann says :

"A persistence of the hypophysis duct is occasionally observed. The pathological processes take place, with few exceptions, in the anterior lobe of the pituitary body, and consist mostly of new growths. Considering its anatomical structure, this glandular portion of the hypophysis shows great resemblance to the glans thyreoidea; there is also a resemblance of remarkable character in some of the pathological processes occurring in these two organs. The most frequent tumor in the hypophysis consists of one or more cysts with gelatin-like colloid contents. Virchow calls this form of new growth struma primitiva."

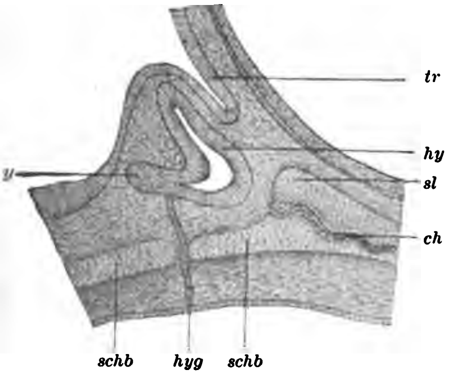


FIG. 6.

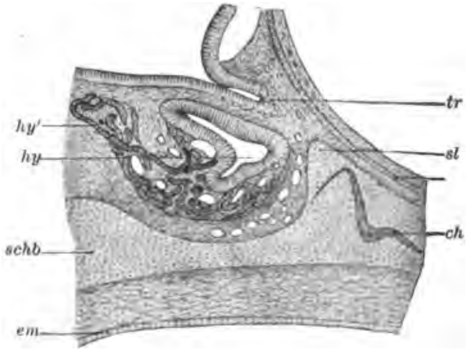


FIG. 7.

FIG. 6.—Sagittal section through the hypophysis of a rabbit embryo 90 millimetres long. Enlarged 55×. *hy*, hypophysis; *hy'*, part of hypophysis with beginning glandular formation; *hyg*, hypophysis duct; *ch*, chorda; *schb*, basis cranii.

FIG. 7.—Sagittal section through the hypophysis of a rabbit embryo 30 millimetres long. Enlarged 40×. After Mihalkovics. *tr*, infundibulum, or processus pinealis; *hy*, originally, hypophysis sac; *hy'*, glandular portion of hypophysis; *ch*, chorda; *schb*, cartilaginous basis cranii.

We therefore see that the explanation which Beck suggested in his case applies as well to the more complicated cases in which the tumor of the sella turcica communicates with another by means of a pedicle perforating the basis cranii. That this communication takes place through the hypophysis duct is not

upper end of the chorda dorsalis (*ch*) is the spot (*hp*) where a part of the pituitary body, a product of ectoderm, begins its development.

A small inversion of epithelium takes place which extends gradually toward the base of the cranium (*tr*, Fig. 5). This is the pocket of Rathke, or the hypophysis sac (*hy*, Fig. 5). This pocket deepens, begins to separate itself from its source of origin (ectoderm), and finally forms a cavity whose wall consists of several layers of cylindrical epithelium (Fig. 6, *hy*).

The hypophysis sac (*hy*) remains for a certain time connected with the oral cavity through a narrow canal (*hyg*, Fig. 6).

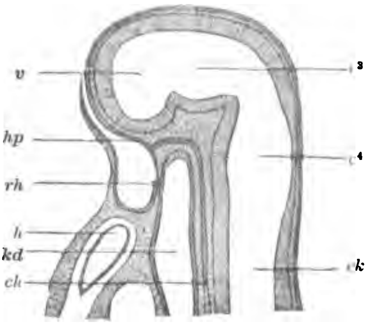
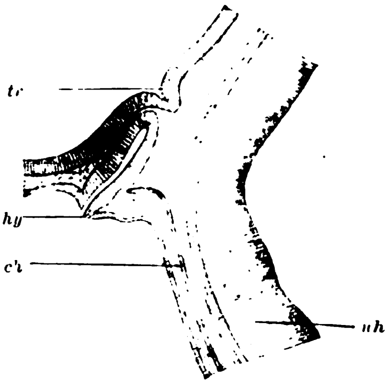


FIG. 4.



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At a later stage this connection ceases. The embryonal connective tissue (*schb*, Fig. 6) which furnishes the substance for the development of the cranial bones increases in thickness, and separates the sac still further from its source of origin (Figs. 6 and 7).

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(Fig. 7). In many vertebrates this canal remains, and, passing through the cartilaginous base of the skull, communicates with the mucous membrane of the mouth.

Therefore we may see how ectodermal and mesodermal cells, displaced in the formation of the hypophysis canal and of the hypophysis, and likewise cells of the hypophysis itself, may, by independent growth, produce tumors which may lie in the sella turcica alone or may communicate through the hypophysis duct with a like tumor of the palate or oral cavity.

Kollmann says :

"A persistence of the hypophysis duct is occasionally observed. The pathological processes take place, with few exceptions, in the anterior lobe of the pituitary body, and consist mostly of new growths. Considering its anatomical structure, this glandular portion of the hypophysis shows great resemblance to the glans thyreoidea; there is also a resemblance of remarkable character in some of the pathological processes occurring in these two organs. The most frequent tumor in the hypophysis consists of one or more cysts with gelatin-like colloid contents. Virchow calls this form of new growth struma primitiva."

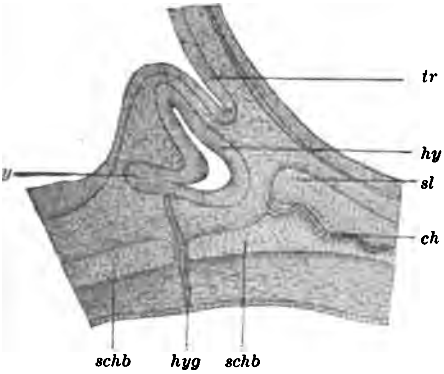

FIG. 6.

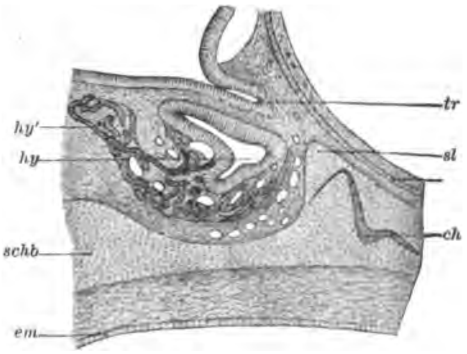

FIG. 7.

FIG. 6.—Sagittal section through the hypophysis of a rabbit embryo 90 millimetres long. Enlarged 55×. *hy*, hypophysis; *hy'*, part of hypophysis with beginning glandular formation; *hyg*, hypophysis duct; *ch*, chorda; *schb*, basis cranii.

FIG. 7.—Sagittal section through the hypophysis of a rabbit embryo 30 millimetres long. Enlarged 40×. After Mihalkovics. *tr*, infundibulum, or processus pinealis; *hy*, originally, hypophysis sac; *hy'*, glandular portion of hypophysis; *ch*, chorda; *schb*, cartilaginous basis cranii.

We therefore see that the explanation which Beck suggested in his case applies as well to the more complicated cases in which the tumor of the sella turcica communicates with another by means of a pedicle perforating the basis cranii. That this communication takes place through the hypophysis duct is not

to be doubted. In addition it may be noted that the epithelium of the oral cavity in the case of Breslau was continuous with the covering of the pharyngeal tumor.

Further remarks about these cases are not necessary, and there is no need to more than observe the various complicated suggestions which Wilms has given concerning these tumors. He says:

> "As to the mode of origin of the heteroblastic tumors, the dermoids and teratomata of the pharynx, of the basis cranii and in the cranium, we must consider: 1. The numerous cleft formations of the head and the processes of inversion in the formation of the mouth and the hypophysis give sufficient opportunity for displacement of cells. 2. Certain forms of the teratoid tumors may originate from a total double formation with subsequent union, or, 3, from a simple formation with partial doubling. 4. An inversion of the form of an inclusio fetus in fetu is, for certain cases in the literature, not to be rejected. Finally, 5, a blastic heteropy in tissues related in origin may possibly be considered. If, finally, we consider various of these processes to be combined, it is clear how difficult in individual cases is the question as to the origin of a teratoma in this region. And yet it is better to bring all these possibilities into the circle of observation, since only in this way can a thorough consideration of all questions be given."

To illustrate still further the errors concerning the question of "fetus in fetu," I quote the following case of Weigert's, reported under the name of "teratoma orbiti congenitum":

> "This case presents *a real fetus,* in that the tumor contains cartilage, bone, epidermal elements, mucous gland cysts, intestine, and even bronchial structures. In a newly-born child was found a tumor the size of an orange protruding from the right orbit. On the summit of this tumor was the cornea, still transparent, but slightly clouded. The tumor with the eye upon it moves in harmony with the eye of the normal side. The tumor, after five days, was removed from the orbit with the adherent lids, and also with the nervus opticus which in a way formed its pedicle. At the autopsy the right orbit was found to be decidedly larger than the left; the surface of the bone, however, was quite smooth and intact. The brain was without any evidence of tumor-growths; the extirpated mass had a pyramidal form. In spite of the puncture of one cyst at the operation, the mass was still the size of an apple. From the inner surface of the cysts stratified ciliated epithelium was scraped. The bulbus was of a size corresponding to the age of the child. Closely attached to the bulbus, but separated by loose connective tissue, were a number of cysts, of which the largest was punctured at operation. The others were of the size of a hazelnut to a walnut. The boundary of the cysts was furnished by a firm membrane; posteriorly the

cysts were surrounded by fatty tissue, in which ran the muscles of the eye, which muscles surrounded the large cysts. Many spaces were present, one of which was noticeable through its peculiar form, resembling intestine or a sausage, thin at one end, thickened at the other, and curved like a sling. Its surface is smooth and shiny, *like the intestine;* it is possible, in contrast to the other masses, to shell it out of its bed. On transverse section it has a star-shaped lumen, because of the protruding folds. These folds are not formed by the entire circumference of the tumor, but only by the membrane which lines it, and which is connected with the external membrane by loose connective tissue. Close to this tube-like structure lie other spaces bounded by a firm but not sharply outlined wall. In the fatty tissue are also islands of firm connective tissue, cartilage, and bone. The first have the macroscopic appearance of hyaline cartilage. One of these cartilaginous and bony structures was likewise easily shelled out, and has an irregular long shape, which, with a certain fantasy, calls to mind an *extremity*.

"*Microscopical Examination.*—The greater part of the compact tissue consists of fatty and connective tissue. The embedded pieces of cartilage have the ordinary structure of hyaline cartilage. The bones are well developed; in the medullary spaces lie round cells; on the walls of the same are osteoblasts. Here and there in the connective tissue lie bundles of unstriped muscle fibres and diffusely scattered red-blood cells. Near these structures are real epithelial masses, partly in long tubes, partly in smaller or larger cystic spaces. The epithelial elements are of three forms. 1. Most rarely they appear in the form of stratified squamous epithelium, the lowest cells being round or cylindrical, the upper ones being large horny cells. The spaces lined with such cells form cysts not larger than a pea; their wall is either smooth or shows irregular papillary projections. The cavity itself is filled with concentrically arranged horny cells without nucleus, forming glistening pearls. A *second* form of cavity is lined with simple cylindrical epithelium which consists of high cells with the nucleus at the periphery; the protoplasm is transparent, the cells are separated by small lines. On the surface there lies often in the larger spaces a cloudy, transparent mucus; such cell masses rest upon a connective-tissue base, partly in long recesses with small lumen or in cystic spaces. They clothe also the above-mentioned tube-like structure, in which they lie, not in a simple layer upon the projecting folds, but forming very regular tubular depressions of the form of the *glands of Lieberkühn.* They rest upon a firm layer, external to which is a loose layer marked off in turn sharply from the external membrane. This external membrane consists of well-developed smooth muscle fibres divided into two layers, an internal circular and an incomplete longitudinal layer. In the connective-tissue stroma lie groups of lymphoid cells. The cysts of the *third* form are lined with a stratified ciliated epithelium, the cells of which are distinguished from the above-mentioned cylindrical cells by the character of their protoplasm, which is not transparent, but slightly granular. In the smaller cysts of this form there is a connective-tissue base, which, however, is interrupted in spots by glandular structures possessing a cylindrical excretory duct and a round fundus. The ducts contain cells with slightly granular protoplasm. The fundus contains cylindrical cells which are pale and transparent. In the larger cysts there is a smooth connective-tissue wall lined with stratified ciliated epithelium."

It is scarcely necessary to call attention to the fantasy which led to calling this tumor behind the eye a "fetus in fetu," a case where the eye, the muscles of the eye, and the lids were completely formed. In connection therewith attention may be called to the fact that the author believed actual intestine and other body structures to be present. We must consider it as granted that ectodermal and mesodermal cells were detached from their normal situation in the complicated process through which the eye was formed, and also in the union of the various parts of which the orbit is composed. At the same time, during the embryonal period the connection between the orbit and the nose is a close one. These three forms of cysts are all of ectodermal origin: (1) The cysts lined with squamous epithelium. (2) Those containing cylindrical cells secreting mucus. These resemble quite decidedly salivary glands. The depressions resembling the glands of Lieberkühn are likewise of ectodermal origin, as we find them, for instance, in cyst-adenomata of the ovary. (3) The cysts lined with stratified ciliated epithelium originate likewise from ectoderm; we find such epithelium in the nose.

Dermoid cysts and teratomata are also found in the abdominal cavity. According to Wilms, Meckel described a tumor situated near the diaphragm which contained twenty-one pieces of bone, four *teeth*, hair, etc. Bonfigli described a pear-shaped tumor in a fold originating from the liver and the stomach. This tumor was 13 centimetres long, 4 centimetres wide, and 470 grammes in weight. It contained a real bone, in which two *teeth* were embedded, while nineteen others, among them eighteen molars, lay free in the cavity. The inner surface was covered with normal hairy cutis for an area of five square centimetres. Marchand describes in the *Breslauer Aerztliche Zeitschrift*, No. 21, the following tumor:

"We have here a tumor of the abdominal cavity of a man, a large teratoma or an inclusio fetalis, a fetus in fetu, therefore a decided rarity. The tumor was an accidental discovery in the cadaver. It was found that the ureter was of normal length, and that the pelvis of the kidney on incision was entirely normal and in no way connected with the tumor. Only at one point, at the upper end of the kidney, which was slightly torn on removal, was the union with the tumor a very close one, while on the remaining surface of the kidney the capsule was easily peeled off, being firmly adherent only at the hilus on its anterior surface where it went over upon the tumor. The anterior surface of the tumor is somewhat rounded, and shows at its lower part a few rounded prominences, which proved to be translucent cysts tensely distended. The anterior surface is almost entirely covered with peritoneum; from above the tumor is covered by the tail of the pancreas, which is only lightly united to the tumor by connective tissue.

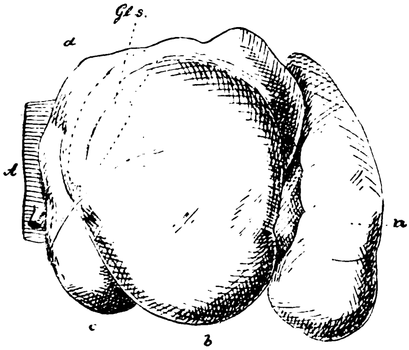

FIG. 8.

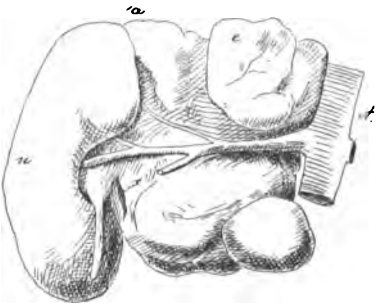

FIG. 9.

FIG. 8.—*A*, aorta; *n*. left kidney, united above to the tumor; *Gl.s.*, left suprarenal gland; *d*, upper end of the tubular cavity containing stones (intestine); *b*, cyst with ciliated epithelium; *c*, cyst with cerebral-like contents.

FIG. 9.—The posterior surface of the cyst, the surface connected with the posterior abdominal wall. *e*, large round mass of cartilage; *A*, aorta; *n*, kidney.

"At first the left suprarenal body could not be found; by careful dissection it was discovered flattened on the anterior surface of the tumor and under the serous covering. The posterior wall of the tumor is loosely united to the posterior abdominal wall, from which it is easily separated. In addition to the cysts also present here, there appears on the posterior surface a large, firm, round mass, which near the upper edge projects near the aorta, is partly covered by a non-adherent connective-tissue membrane and partly connected with a connective-tissue membrane which extends like a band over a few recesses. This mass consists of very firm, compact bone, and in its form resembles somewhat the calcaneus. Of special interest are the cysts. The largest, situated at the lower limit, contains a thick, cloudy, grayish fluid like the contents of an ovarian cyst. The inner surface of the cyst has the appearance of a white or pale-red mucous membrane; it shows epithelium, the cells of which are distinguished from the abovementioned cylindrical cells by the character of their protoplasm, which is not transparent, but slightly granular. In the smaller cysts of this form there is a connective-tissue base, which, however, is interrupted in spots by glandular structures possessing a cylindrical excretory duct and a round fundus. The ducts contain cells with slightly granular protoplasm. The fundus contains cylindrical cells which are pale and transparent. In the larger cysts there is a smooth connective-tissue wall lined with stratified ciliated epithelium."

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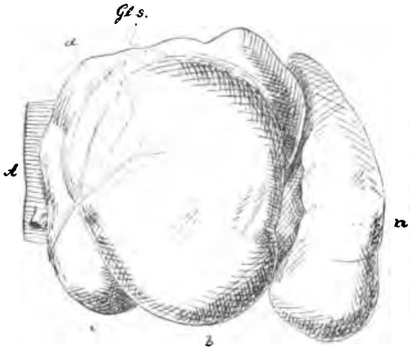

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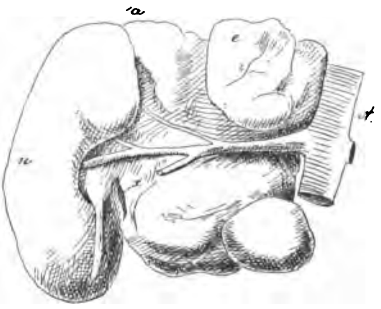

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"If, on the one hand, we are to classify this tumor from the anatomical and histological evidences, and, on the other hand, if we are to bring forward an explanation of its origin, then in the first place, according to the now existing views, there can be no objection to considering as a teratoid growth depending upon fetal malformation this tumor in the sella turcica, containing as it does cysts with colloid contents. *teeth,* bone, and cavities lined with ciliated epithelium. To explain the origin of this teratoma several possibilities must be taken into consideration. In the first place, we may think of an inclusio fetus in fetu—*i.e.*, an entirely individual twin, restrained in its development and enclosed in the skull of its autosite; or we may be dealing with a parasite form of partial embryonal cell division, a duplicitas anterior or posterior; finally, however, this growth may be considered as having originated from displaced cells of the fetus or of the hypophysis itself. An inclusio fetus, the enclosing of a fetus fully separated from the other in the sella turcica of the other, may be explained in two ways. The first view is that which Ahlfeld accepts in the case of epignathi, of teratoma in the sella turcica, and of teratoma of the cranial cavity inside of the dura mater. Two fetuses lie head against head very close to each other, on one blastula. If the one in a very early embryonal period, for some reason, is retarded in his development, he will gradually come nearer to the other growing fetus. At first situated near the anterior part of the amnion of the growing embryo, it soon reaches the anterior turning point of the head of the same, and, going along the turning point of the amnion, *comes into the neighborhood of the oral cavity, and then goes into the sella turcica, and even further into the brain, over the same road which the so-called hypophysis sac takes,* this sac, a protrusion of the ectoderm, being the structure from which the hypophysis develops. In this way, according to Ahlfeld, all epignathi may be explained: those situated anteriorly in the palate, those on the neck, even those attached to the sella turcica and those furnishing the largest number of brain teratomata. The second path which a fetus situated in the sella turcica of a second fetus may take is not that through the mouth, but through *the cephalic end of the medullary canal,* which Kölliker says remains open for a relatively long period (!). The fetus makes its way then to the seat of the pituitary body, so that it finally lies in the infundibulum, an outgrowth of the hypophysis. It is of advantage, in deciding which of the above-mentioned modes of origin will explain the presence of the tumor in question, to compare the same with other teratomata in the sella turcica. It must be stated that the other teratomata contained complicated but genuine fetal organs, and that in addition other malformations were present, such as cleft palate, persistence of the sphenoidal canal, and disturbances in the development of the base of the skull and of the brain, none of which failures are present in our case. The structure of this tumor is relatively uncomplicated; it lies almost entirely in the sella turcica. No other malformations were seen in the patient. These facts speak against a fetal inclusion or partial parasitical cell division, and the structure of the tumor makes another explanation more probable. As we see that in our case the epithelium as well as the connective tissue has taken on an abnormal character in its growth, in that they have produced teeth and real bone, it is natural to believe that a part of the anterior lobe of the hypophysis, after its detachment from the pharynx, has preserved its ability, for some reason, to form teeth and bone. It must be mentioned here that that part of the oral mucous membrane from which the hypophysis is developed lies near the future seat of development of the posterior teeth of the upper jaw. Even the presence of ciliated epithelium in this tumor is not strange, since Peremeschko has shown that the canal which forms the hypophysis possesses *de norma* ciliated cylindrical epithelium. At any rate, the fact that in this case in various parts of the tumor pituitary tissue is present shows that the hypophysis has undergone teratoid growth only partially. At least there is the greatest probability that this teratoma is truly a teratoma of the hypophysis cerebri."

That Beck touched closely upon the correct explanation in his case may be seen from the following embryological review. It is also clear that this explanation covers all the cases quoted and discussed by him, as well as the case of Breslau and Rindfleisch. It would be remarkable to consider the tumor described by Beck the result of a displacement of cells, and yet view the other cases, even if they communicate with a palatal growth through the hypophysis canal, epignathi according to Ahlfeld, since in both classes the same tissue formations are present. It will be scarcely necessary to discuss further the fantasy of the theories of Ahlfeld and others. It is rather remarkable, at any rate, that such views could really have been accepted seriously—the idea that a fetus could make its way into the brain through a canal in the sella turcica or through the cranium to the base of the skull. At the same time we recognize the force of imagination which influenced those authors, for whom the idea of a fetus in fetu possessed a certain reality, to describe eyes, mouth, extremities, intestine, etc., as components of these growths.

The following illustration follows that given by Hertwig. To appreciate the beginning of the formation which results in the hypophysis, we may see in Fig. 4 that the oral cavity (*hp*) is separated from the cephalic portion of the primary alimentary canal (*kd*) by the pharyngeal membrane (*rh*). At the

upper end of the chorda dorsalis (*ch*) is the spot (*hp*) where a part of the pituitary body, a product of ectoderm, begins its development.

A small inversion of epithelium takes place which extends gradually toward the base of the cranium (*tr*, Fig. 5). This is the pocket of Rathke, or the hypophysis sac (*hy*, Fig. 5). This pocket deepens, begins to separate itself from its source of origin (ectoderm), and finally forms a cavity whose wall consists of several layers of cylindrical epithelium (Fig. 6, *hy*).

The hypophysis sac (*hy*) remains for a certain time connected with the oral cavity through a narrow canal (*hyg*, Fig. 6).

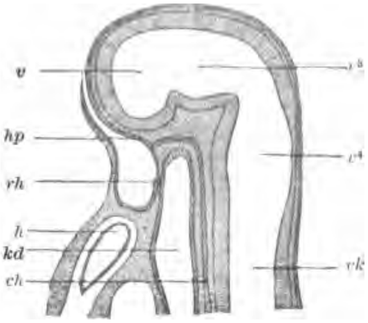


FIG. 4.

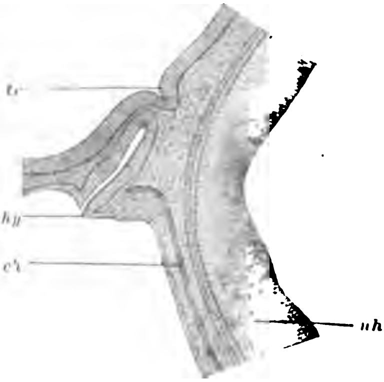


FIG. 5.

FIG. 4.—Median section through the head of a 6-millimetre-long rabbit embryo. After Mihalkovics. *rh*, pharyngeal membrane; *hp*, spot from which the hypophysis develops; *kd*, primary alimentary canal; *ch*, chorda dorsalis; *v*, v^4, brain ventricles; *ck*, central canal of the spinal cord.

FIG. 5.—Median sagittal section through the hypophysis of a 12-millimetre-long rabbit embryo. After Mihalkovics. Enlarged 50 ×. *tr*, base of the subsequent processus pinealis; *hy*, hypophysis sac, or pocket of Rathke.

At a later stage this connection ceases. The embryonal connective tissue (*schb*, Fig. 6) which furnishes the substance for the development of the cranial bones increases in thickness, and separates the sac still further from its source of origin (Figs. 6 and 7).

When finally in this connective tissue the development of cartilage takes place which eventually furnishes the cartilaginous base of the skull, this hypophysis sac (*hy*) lies above this base and on the under surface of the other lobe of the pituitary body (*tr*, Fig. 6). At this time also the hypophysis canal (*hyg*) has lost its lumen, shrinks, and begins to disappear

(Fig. 7). In many vertebrates this canal remains, and, passing through the cartilaginous base of the skull, communicates with the mucous membrane of the mouth.

Therefore we may see how ectodermal and mesodermal cells, displaced in the formation of the hypophysis canal and of the hypophysis, and likewise cells of the hypophysis itself, may, by independent growth, produce tumors which may lie in the sella turcica alone or may communicate through the hypophysis duct with a like tumor of the palate or oral cavity.

Kollmann says:

"A persistence of the hypophysis duct is occasionally observed. The pathological processes take place, with few exceptions, in the anterior lobe of the pituitary body, and consist mostly of new growths. Considering its anatomical structure, this glandular portion of the hypophysis shows great resemblance to the glans thyreoidea; there is also a resemblance of remarkable character in some of the pathological processes occurring in these two organs. The most frequent tumor in the hypophysis consists of one or more cysts with gelatin-like colloid contents. Virchow calls this form of new growth struma primitiva."

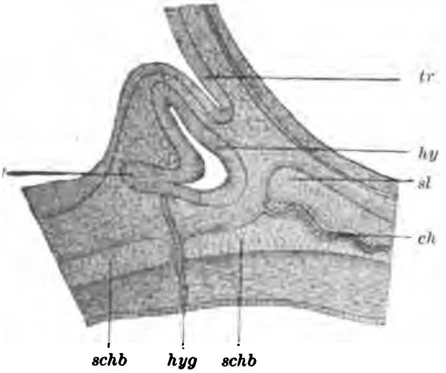
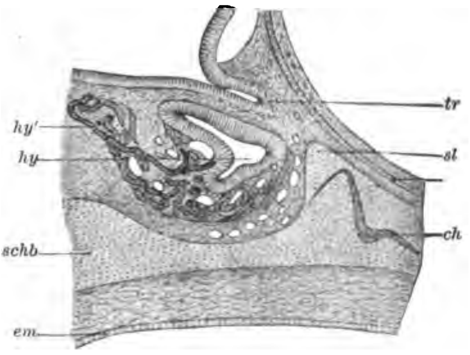


FIG. 6.



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We therefore see that the explanation which Beck suggested in his case applies as well to the more complicated cases in which the tumor of the sella turcica communicates with another by means of a pedicle perforating the basis cranii. That this communication takes place through the hypophysis duct is not

plained the origin of mixed tumors of the kidney through cells displaced by the Wolffian body. But the point of development of the "first kidney" is also near the primary intestinal mesentery, and the mesodermal cells in which the Wolffian body lies form at a later period the permanent mesentery. In this way displaced cells, just as they cause dermoids in the region of the kidney, may cause the same sort of tumors in the mesentery. In Fig. 12 we see the Wolffian body and the primary mesentery; and when we consider what great wanderings and changes of location the latter makes during the development of the intestine, and when we consider further that a part of this primary mesentery forms the omentum and that in this primary mesentery the liver, pancreas, and stomach are formed, we may then understand that it is only a question of chance in which of these situations those cells develop which have been displaced or carried into the primary mesentery.

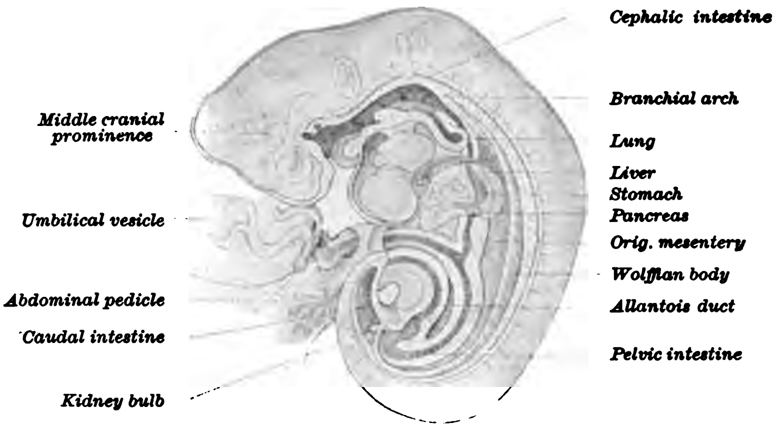

FIG. 12.—Human embryo, 5 millimetres long. Sagittal section. Reconstruction. After His.

It is therefore not necessary to consider such cases as occur in the omentum fetus in fetu or inclusio fetalis. In the case mentioned by Pommer, Wilms found it necessary to consider this tumor a dermoid cyst of the ovary, although at the operation it was plainly recognized as a teratoma of the omentum. Wilms adopted his explanation, since it harmonizes with his theory of parthenogenesis and the tumor was of no interest to him as an epignathus. Wilms[1] says concerning this case:

"The case of Pommer does not seem to me to be beyond criticism as regards its explanation. In opposition to the author I consider it a dermoid cyst and not a teratoma. As fetál inclusion in the omentum Pommer describes a tumor of the size of a child's head which lay above the symphysis, was adherent to the anterior abdominal wall, and was only fixed to the uterus by a band. Even though in the referat in the *Centralblatt für Allgemeine Pathologie,* from which I quote this case, no further statements are made concerning the ovary, yet I venture to *consider this tumor as an ovarian dermoid cyst* (*!*) The structure of this tumor, which agrees so noticeably with other dermoid cysts of the ovary, justifies me, I believe, in forming this conclusion. So far as the advanced necrosis and the decided calcification of the wall permitted of examination, connective tissue, smooth and striated muscle were found to be the constituent structures of the capsule. Within, normal hairy skin was present as the lining membrane. The tumor was filled with a number of joint-like structures covered with skin, which adhered to the capsule with broad surfaces and were united to each other by plaited membranes. These stump-like structures consisted chiefly of connective and fatty tissue in which were situated pieces of cartilage, bone, and voluntary muscle. One tissue area resembled the cartilage of Meckel with a bony lower maxilla formation. Of further interest was an area containing a profuse grouping of brown-black pigment granula in a tissue whose cells could be indistinctly recognized. *Possibly* we have here, according to the judgment of the author, a rest of an eye formation. Completely formed ragged teeth projected here and there, enclosed in tooth sacs, from the spaces between the stumps. A sac-like hollow structure with a perforated prolongation the author considers to be the cecum with the processus vermiformis. As already mentioned, he views this tumor as an individual formation parasitically implanted into a sister individual. Yet the entire structure of the cyst, as well as the pedicle continuing into the uterus, points in a distinct way to the fact that we are dealing here with an ovarian dermoid."

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[1] Archiv. f. klinische Medicin, Band lv.

Since this description speaks for itself, I will not criticise further the standpoint of Wilms. I would recall the fact that the tumor of Bonfigli lay in a strand originating from the liver and from the stomach, and that the tumor of Meckel was situated at the diaphragm. Since these growths, according to our theory, are the result of displaced cells, for which displacement the Wolffian body is responsible, the following case is of decided interest. The genital gland (ovary or testicle) originates high up in the abdomen. We may therefore easily understand from the following description why the above-mentioned dermoid cysts were situated in this uppermost part of the abdominal cavity. Pommer described "A

Union of the Left Cryptorchic Testicle and the Epididymis with the Spleen in a Premature Fetus, together with Numerous Anomalies of Development." He says:

> "The origin of this condition—a like case was not found noted in the literature—is certainly to be dated back to that period of embryonal development in which the anterior portion of the 'first kidney' and the Wolffian duct (later the head of the epididymis and the vas deferens) extend up to the region of the liver and are united to the diaphragm by the diaphragmatic band of the Wolffian body. Since the spleen develops in this region, a union between it and the cells of the subsequent epididymis may be taken for granted, even though a special cause for the same cannot be mentioned. During the descent of the testicle a band-like stretching of the adhesion occurred, and the testicle was retained in the abdominal cavity through tension of this band."

To illustrate this condition still further, and to show the importance of a displacement of cells and their future growth, and likewise to prove that cells of varying combinations may be displaced, I group together the following from Wilms' "The Mixed Tumors of the Kidney." The mixed tumors of the kidney which have been described as rhabdomyomata, chondrosarcomata, angiosarcomata, myxosarcomata, and sarcomata occur, as a rule, at a youthful period, mostly in children during the first three years. One case in a fetus has been described. These are situated mostly in the pelvis of the kidney or in the substance of the kidney, and grow into it as something foreign. In two cases they were situated outside of the capsule of the kidney, which speaks against their origin from the kidney tissue itself. In one case the colon lay behind the tumor. In addition to glandular structures are found smooth and striated muscle, cartilage, fat, elastic fibres, colloid and fibrous connective tissue, etc.

Eberth expressed the view that these mixed tumors originate from remains of the Wolffian body. Birch-Hirschfeld agrees with the theory that they originate from the Wolffian body. He seems to have reached this conclusion through his explanation of the glandular structures as Wolffian-body canals. Vogler believes also that these tumors may be referred to remains of the Wolffian body. Muus and Brosse believe that the tumors develop from the cells forming the permanent kidney. Wilms believes that the kidney mixed tumors originate from mesodermal cells in the neighborhood of the Wolffian body, and calls them mesodermal tumors.

The glandular structures in these tumors have been variously explained by different authors. Birch-Hirschfeld believes that the glands are preformed and are detached from the Wolffian-body formation. Vogler says that it is still an unsettled question whether these glands are of epithelial or connective-tissue origin. The same question exists concerning the permanent kidney (Hertwig). There are weighty opinions which hold to the view that the entire kidney is of epithelial nature, while others believe it to originate from the mesodermal layer (the former view is surely the correct one). Brosing considers the glandular structures to be lymph vessels. Perthes leaves the question open and says that the cells resembling epithelium are nothing other than cells of the sarcomatous groups.

Wilms' view is as follows: The tubular glands are not primary structures, but are outgrowths of certain cells of the embryonal tissue still in the stage of differentiation. From this embryonal tissue (the mesodermal cells in the region of the Wolffian body) originate all the above-mentioned structures and also the glandular elements. The round cells of these tumors are not sarcoma cells; they are embryonal cells which in their younger periods have round-cell forms, and later, on differentiation, form epithelium and glands. These cells must originate from a common area, because cartilage and striated muscle fibres are not found in the Wolffian body, and a displacement of cells forming these tumors from the structure of the Wolffian body alone, as Birch-Hirschfeld and others believe, without participation of the mesodermal cells, does not explain the presence of these two tissues. "We might grant," says Wilms, "that these tissues are first displaced into the Wolffian body and from there enter into the kidney, and we would then, at any rate, be following the generally accepted view, according to which all mixed tumors result from a group of displaced cells belonging to various already differentiated tissue complexes."

Personally I do not believe that the displaced cells must be already differentiated.

Wilms says further that all striated muscle fibres originate from the myotom, smooth muscle fibres from the mesenchym and from mesenchym cells, and that from the "primary segment" develop mucous tissue, fibrillary connective tissue, cartilage, bone, lymphoid structures, etc. The glandular structures originate from the "middle plate," because in the middle plate the first formation of the Wolffian body makes its appearance; in this "middle plate" originate also the germinal epithelium, the Wolffian canal, and the ducts of Müller. In these last views Wilms is in error, for the germinal epithelium, the Wolffian canal, and the ducts of Müller *are of ectodermal origin,* since the Wolffian canal appears near the ectoderm and originates from the ectoderm, and later makes its way deeper up to the celom epithelium. Glandular structures cannot originate from mesoderm.

Fig. 13 we may see Wilms' view as to these tumors and the region from which he believes the cells of the mixed tumors of the kidney to originate. From his description I doubt very much that in some of these cases epithelial gland

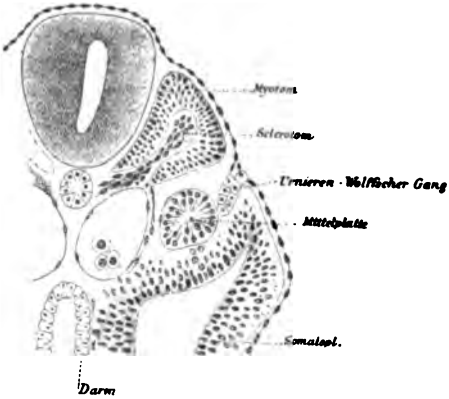

FIG. 13.—Section through a "primary segment," at the posterior body end of a three-weeks-old human embryo. After Hertwig.

structures or epithelial elements were present, and observe that Wilms excludes from this category that tumor in which Birch-Hirschfeld leaves the question in doubt as to the characterization of the "supposedly epithelial elements and spaces present." This question has for us a special interest, because I consider it possible that, when cells are here displaced, not always cells destined to produce *all the various connective-tissue structures* are removed from their place of origin, and that not always remnants of the Wolffian body must be present, just as it occurs that sometimes dermoids consist mainly of ectoderm, and other dermoids evidence mesoderm products to a greater or lesser extent, while in still others all the various products of these two layers are present. Wilms says:

"It would furnish difficulties, the fact that in some cases cartilage or fatty tissue is absent in the tumors. It is possible that certain tissue forms of the mesenchym, such as cartilage and fat, come to development only under certain external conditions. Secondly, certain tumors, in spite of the presence of these cells, may not have brought certain tissues to development, because, in addition to other requirements, they need a quieter and slower growth. Thirdly, we might adopt the view that only a part of the already differentiated mesenchym is displaced, or, finally, that certain tissue forms of the mesenchym may have been destroyed at an early period by others" (?).

If in place of these various hypotheses we accept the explanation that only a part of the mesenchym is displaced in the various cases, we may then easily understand why, in the various mixed tumors of the kidney, the mesodermal products appear in varying amount, and why certain tissue forms may fail entirely.

Since writing this explanation I find in Wilms' "Mixed Tumors," volume ii., 1900, that he has come to the same conclusion; and since a case quoted therein furnishes a splendid support to the above given explanation of the origin of retroperitoneal and mesenterial dermoids, I mention the following: In a work by Muus a mixed tumor of the kidney is described in which horny pearls were found. These were surrounded by epidermis-like cells. The presence of a stratum mucosum granulosum with keratohyaline nuclei, and a stratum corneum, make the resemblance to epidermis absolute. "How does it happen," says Wilms, "that in the mixed tumors of the kidney, which we have viewed as mesodermal tumors, ectoderm likewise may be present? During the displacement of cells, cell complexes must have been removed which *contained both ectodermal and mesodermal cells.* This fact is a further evidence that such a displacement of cells is not always a process of regular character, but one which occurs with all possible variations, in that at one time more, at another time fewer, cells are freed from their connection." We have therefore shown the mode of origin of the retroperitoneal dermoids, and have furnished proof of the possibility of a displacement of various forms of cell combinations. Exactly as, in the region of the kidney, mesodermal mixed tumors occur, in the same way may combinations of ectodermal and mesodermal tumors be formed; then we have dermoid cysts. The tumors which we have considered so far contained most differing tissues; it may be specially noted that in all other various portions of the body mentioned *teeth and intestine-like tubes* are found; we have found teeth in dermoids of the hypophysis, in dermoids of the orbita, in dermoids of the neck, and in mediastinal and abdominal as well as retroperitoneal dermoids.

The origin of the teeth is to be explained through the united presence of ectoderm and mesoderm in these tumors. It is, at any rate, difficult to understand why, in the higher vertebrates, teeth normally occur only in the mouth, for those tissue combinations which are necessary for the building of teeth, as occurs in the oral cavity, are likewise present in other parts of the body. Kollmann says: "The early cell formation and development of the teeth comparative anatomy explains as a continuation of the tooth formation present upon the surface of the body of the lower vertebrates (the Selachier). The skin teeth, an evident organ of protection, are continued on into the oral cavity. Upon the jaws they reach, with their higher function, also a higher stage of development. Their development in *epithelium with the aid of the mesoderm is a primary occurrence.* Even in the lowest animal forms the teeth develop only through the participation of both these tissues." The teeth in dermoid cysts may lie scattered in the wall or may be found only in one part; they may be embedded in connective tissue or situated upon a bony or cartilaginous base; they may lie free in the cell contents. The teeth are for us a condition of greatest interest, and have obstructed the proper explanation of dermoid cysts and teratomata, for they have been considered as originating only in the oral cavity. We must consider the question in the following manner: Were the dermoids of the hypophysis and the dermoids of the palate really fetal monstrosities, then every so-called "epignathus" is a dead fetus. What gives this fetus, then, the power to continue its growth, and, among other things, to form teeth? In the case of Bonfigli, in which the tumor lay in the region of the liver and the stomach, teeth were likewise present. If this is really to be viewed as an engastrius, as Wilms desires, what gave this dead fetus the power, instead of forming a lithopedion, to grow to such an extent that twenty teeth were formed? At the same time it must be mentioned that on the inner surface of this tumor only an area of five square centimetres was covered with normal hairy skin. The case of Bardenheuer, which Wilms grants to have originated through the participation of the Wolffian canal, likewise contained teeth, so that we have at least one case in which we may draw the conclusion, with the consent of all the authors, *that teeth may be formed without the presence of a second fetus.* I believe that we must explain this fact from a logical and embryological standpoint, as given above. If all these dermoid cysts, as must now be granted, originate from displaced cells, then these cells are cells of the porteur and rightly possess the same energy as the cells remaining in their normal situation. For that reason they grow at the same rate as the normal tissue cells, and the resulting dermoid cysts are therefore observed most *frequently during or after puberty.* In this way the occurrence of well-formed permanent or second teeth may be explained. Were these tumors, on the other hand, really fetus in fetu, we should expect to find mainly striated instead of smooth muscle fibres in these tumors. Although we shall later consider the difference between dermoid cysts and teratomata (solid dermoids) on the one hand, and double formations or monstrosities on the other, yet I would here express the opinion that a tumor in which teeth are present in all probability cannot be viewed as the remnant of a fetus.

As a further proof of the possibility of a displacement of cells may be mentioned the mixed tumors which occur in other parts of the body, as in the cervix and the vagina. We know, further, that small lipoma-like round growths occur in the kidneys, which, according to Grawitz, are to be considered as displaced pieces of fat-containing suprarenal tissue. According to Marchand accessory suprarenal bodies also occur in the ligamentum latum and in the vicinity of the ovaries. Accessory mammary glands also occur near the mamma and likewise at a distance, on the abdomen and the upper extremity. These, as well as accessory thyroid glands and accessory spleens, are only to be explained through a displacement of cells. If these cells be removed from their normal situation during the earliest embryonal period, they are at that time not yet differentiated and form later ectodermal and mesodermal structures. In that way ectoderm forms epidermis, enamel of the teeth, nerve cells, so-called "glia cells," etc.; mesoderm forms muscle fibres, fatty tissue, cartilage, bone, teeth, lymphoid tissue, etc.; ectoderm forms further glandular structures "like those in the intestine," as well as other cystic structures. If, on the other hand, these cells are displaced at a later period, when they are already differentiated and are already destined to form certain organs, they then form at that spot to which they have been carried organic structures, such as mamma on the upper extremity, and suprarenal gland in the ligamentum latum, etc. Formerly it was difficult to understand how chondromata could develop in the parotis, and the theory of metaplasia was adopted. Now these cases are explained through displaced mesodermal cells.

Although the retroperitoneal dermoids do not belong to our first category, namely, dermoids at places of union, yet we have mentioned them here to show the errors made in explaining difficult cases as fetus in fetu. To our first category belong also dermoids and teratomata of the spinal canal and dermoids in the coccygeal region (partly). Here likewise decided errors have been made through the acceptation of the terms "double monstrosities," and "parasitical double monstrosities" and "teratomata." Exactly as malformations occur in other clefts and points of union, so do we find the same forms in the region of the spinal canal and the coccyx. Wilms mentions a case of Sloman. In this congenital tumor, situated in the neck of a 15-year-old girl, were found bone, teeth, structures resembling some of the facial parts, skin, and mucous membrane. The teeth were milk-teeth with formative evidences of second teeth. Wilms says: "Sloman considers this case, and with justice, to be a parasitic formation greatly limited in its development and therefore in an extremely rudimentary stage. Here we may again consider all the various theories concerning double formation, yet an answer would be dealing only with possibilities and would therefore be more or less useless." I would ask how, even if dealing with probabilities, we can explain as a double monstrosity a case containing, among other structures, teeth. The medullary plates are capable of forming each a fetus and of producing in this way a double monstrosity. Then, however, one fetus, if its entity be lost and if it be "in an extremely rudimentary stage of development," is not found in the neck of the other. Since clefts occur in the entire length of the spinal column (viz., spina bifida, hydrocele cerebri, hydromeningocele sacralis et coccygea) and in the occipital region (hydrocele cervicalis), this case of Sloman simply is an evidence of the occurrence of a dermoid in the cervical region, just as dermoids occur in the coccygeal region and at other points of union.

This Fig. 14, taken from Ziegler, after Von Recklinghausen, shows how, through a malformation of the spinal canal, a displacement of tissues has resulted in the formation of a tumor.

In this growth it was mainly mesodermal elements which went on to development. It may be seen, however, that the ectoderm cells have caused a pathological skin formation, so that the skin, usually clear at this point, shows a rich growth of hair. Had ectoderm cells been displaced at the same time, we would then have had the basis for the development of a dermoid containing epidermis and hair.

As has been mentioned before, the congenital sacro-coccygeal tumors are divided into (1) simple dermoids, (2) complicated dermoids, (3) teratomata, (4) cystosarcomata. The dorsal cysts, according to Mallory, are analogous to the malformations occurring in the branchial clefts. Tillmanns says:

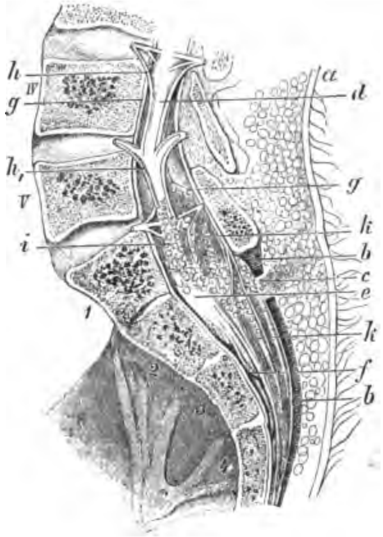

FIG. 14.—Spina bifida occulta with myolipoma in the vertebral column. Sagittal section one centimetre to the left of the median line (after Von Recklinghausen). *a*, abnormally hairy skin; *b*, fibrous cover as a dorsal wall of the sacral canal, with the cleft *c*; *d*, spinal cord; *e*, conus medullaris, situated at the second sacral vertebra instead of at the second lumbar; *f*, cauda equina; *g*, dura mater; *hh*. recurrent anterior nerve roots of the third and fourth lumbar nerves; *i*, fat tissue; *k*, muscle bundles, IV. and V. lumbar vertebræ, 1-4 sacral vertebræ.

> "Some of these are to be considered genuine teratomata—*i.e.*, cystic growths which contain cartilage, bone, rudimentary intestine, brain substance, nerves, muscle, glandular structures. We are concerned here with parasitical double monstrosities—*i.e.*, fetus in fetu—and the various tissue forma-

tions found in these tumors are to be considered as rudiments of the skeleton and of the organic portions of an incorporated distorted fetus. In other cases the various tissue forms in the tumor are to be considered only as displaced cells, which have been taken up by the body and surrounded (inclusio fetalis)."

We see here that the expression inclusio fetalis is limited to displaced cells. Tillmanns says further:

"The congenital dorsal cystic tumors, the inversions of skin, and the fistulæ of the sacro-coccygeal region are, according to Mallory, analogous to the branchial fistulæ, and are to be considered as failures of development of the medullary canal and the spinal canal. Also in these tumors, situated anteriorly or posteriorly to the sacrum and coccyx, portions of intestine are found, which are not to be considered as fetal inclusions, but are rather to be considered as coming from the postanal caudal intestine and the neurenteric canal (the union of the caudal end of the intestinal canal with the end of the medullary canal)."

We see, therefore, that in this region likewise a sharp line of division is needed between double monstrosities and those formations resulting from displaced cells. The word teratoma is used with such varying signification that I show one of the existing views—*i.e.*, of Ziegler:

"Under the name of teratoma we understand tumor formations which consist of a large number of different tissues and in that way are distinguished from ordinary tumors. Some of these contain rudiments of portions of the skeleton, for instance, a spinal column, a pelvis, rudiments of various normal organs and tissues, such as intestine, brain, different glands, nerve and muscle tissue; others contain indeed tissue formations, such as muscle tissue, cartilage, skin tissue, bone, glandular tissue, cysts, etc., but no tissue pieces which may be considered rudiments of a definite part of the skeleton or of an organ. The first are indeed, with certainty, parts of a distorted fetus—*i.e.*, acardiaci amorphi which are closely united to the developed fetus. The latter, on the contrary, are more probably the result of a disturbance in the development of a single fetus—*i.e.*, of a displacement of cells."

Here we see that the name teratoma means for Ziegler either a double monstrosity or a formation the result of displaced cells. We see further how difficult it is to make a definite decision without closely viewing each individual case. It is, however, desirable to introduce a different nomenclature for these two entirely different forms. I include under the name teratoma only solid dermoid cysts. It is, at any rate, of importance to observe that Ziegler grants to the solid dermoid cysts various tissue formations, such as muscle, cartilage, skin, bone, glandular tissue, cysts, etc. Ziegler says further:

> "Viewed from the above-mentioned standpoint, an epigastricus and an epignathus are also teratomata, *so far, at least, as their development sinks below a certain level.* In addition, they form most frequently extensive tumors at the extremity of the coccyx which are called sacral teratomata or teratoid sacral tumors. If the tumor presents formations which, when viewed externally, resemble parts of a fetus, then the diagnosis is not difficult that we are concerned with an unequal double monstrosity, and we call it an epipygus. The diagnosis is more difficult concerning tumors which show no special form; here the anatomical examination decides, wherein that which has been said about teratomata in general is decisive in making a diagnosis. Thereby it must be considered that in this sacro-coccygeal region there also occur, in the newly-born, and with the same forms as in teratomata, tumors which belong to the ordinary connective-tissue tumors as well as to the epithelial tumors."

It is clear how absolutely impossible it is to make from the above views a definite line of distinction. It seems, however, that in the case of dermoids in the sacro-coccygeal region just as grave errors of classification have been made as in the case of dermoids in the cranial cavity and in the mouth. So much, however, can be said: The quoted cases of Breslau and Beck, and the cases of Beck referred to but not quoted, *are surely not epignathi*, and the cases of Bonfigli, Meckel, etc., *are surely not engastrii*, but are to be explained only by our theory of a further growth of displaced cells.

Ziegler, following Ahlfeld, says:

> "An epignathus is an acardiacus amorphus which is united to the oral cavity of its twin brother. Out of the oral cavity there protrudes, as a rule, a shapeless mass covered with skin which consists of cartilage, connective tissue, glandular tissue, brain substance, teeth, bone, intestinal structures, muscle, and skin with fine hair. In only rare cases is the epignathus situated at another point—for instance, at the orbit. An acardiacus amorphus consists of a formless mass covered with skin and containing only rudiments of organs; it is rare."

Thereby we find ourselves by no means compelled to recognize all such epignathi as twin brothers, nor to consider as a double monstrosity a tumor whose contents resemble, on observation, parts of a fetus; for we have already seen how, through stretch of imagination, intestine, eyes, extremities, cranium, bladder, prostate, etc., have been described by various writers. If the tumor shows bone structures positively recognizable or organs verified beyond question, if its own surface is real skin, then a twin brother may be considered to be present. To show the errors still more clearly, I quote the following by Ziegler concerning inclusio fetalis:

> "As regards teratomata, the parasite or the displaced cells are taken up and surrounded more or less by the growing body. If the teratoid tumors are taken up still deeper into the structure of a fetus, so that they appear externally only to a slight degree or disappear entirely, they are then considered as inclusions. According to their position we divide them into (*a*) inclusio abdominalis (engastrius), (*b*) inclusio subcutanea, (*c*) inclusio mediastinalis, (*d*) inclusio cerebralis (teratoma gldl. pinealis), (*e*) inclusio testiculi et ovarii."

It is to be observed that in this classification either a parasite or displaced cells are considered under "inclusio fetalis," a fact which, if it does not lead to error, at least makes no clear definition. Besides, one may therefrom draw the conclusion that a fetus may make its way into the mediastinum or into the pineal gland or into the testicle or ovary and there continue its growth—an idea which is not alone erroneous, but which also interferes with a proper conception of the mode of occurrence. It has been shown that the cases of Zweifel, Bardenheuer, Marchand, Meckel, Bonfigli, etc., are not engastrii, and that the dermoid cysts of the mediastinum are to be explained by cell displacement, and that the teratomata of the hypophysis are caused by cells dislocated during the formation of the hypophysis canal. The same mode of origin holds good for the teratomata of the pineal gland. Finally, the expression "inclusio testiculi et ovarii" is a false one, for no one believes in the entrance of one fetus into the ovary of the other—a view which might be easily taken from the arrangement adopted by Ziegler. The mode of origin of the dermoids and teratomata of this latter organ deserves special explanation.

With regard to the pineal gland Kollmann says:

> "In the first place, it must be firmly fixed in mind that that organ (epiphysis) is of ectodermal origin, together with the entire medullary plate, and that for its development only spongioblasts are used which constitute a second generation of ectoderm cells. If in a tumor of the epiphysis horny struc-

tures, hair, and sebaceous glands are found, this points surely to ectodermal origin. Cartilage, fat, and smooth muscle fibres which also occur in such tumors, together with the mentioned epithelial structures, come from an invasion on the part of the mesoderm during embryonal growth."

As to double monstrosities, we may adopt with Ziegler the following definition:

"Double monstrosities are malformations in which the entire body or a part of it is duplicated. The parts thus doubly present are sometimes equally, sometimes unequally developed. In the latter case one part is distorted and appears as a parasitical dependent growth of the well-developed individual. All double monstrosities come from one ovum and develop on one blastula. They develop because the medullary plates of the primitive trace develop separately in their entire length or in parts. For the presentation of the monstrosities here considered it is better to lay aside the possibility of secondary union of separated formations, and to consider all double monstrosities as originating from an incomplete division of one fetal formation."

(Concerning the origin of double monstrosities, Förster, Virchow, Ahlfeld, and Gerlach speak for this theory of division.) It seems that this fact is proof of the error in Ahlfeld's view concerning epignathi, and it likewise speaks against the theory of engastrii, and especially against a like view in the case of Sloman. That very many of the tumors occurring in the sacro-coccygeal region and described as double monstrosities are nothing more than cystic or solid dermoids is not to be doubted. This question cannot be discussed further, since every case must be judged individually. We have considered this matter to show the existing errors, since there is a tendency to call every tumor of complicated structure containing bone, cartilage, glandular structures, etc., a double monstrosity

Kümmel described a congenital tumor in the sacro-coccygeal region made up of two parts:

"The rounded masses on the inside are connected *only loosely* with the skin covering the tumor externally. The tumor enters upward into the pelvis and is inserted in a fairly broad ligamentous surface on the anterior side of the sacrococcygeal bone. The arches of the sacral vertebræ are closed by ligaments, likewise the first coccygeal vertebra. The following coccygeal bone is present, a third can be made out, a fourth can scarcely be recognized. The dura of the spinal canal is entirely unchanged.

"The rectum extends in a large curve in front of and above the tumor, so that the anus lies gaping two centimetres posterior to the base of the scrotum, and vertically under the symphysis. As groundwork of the entire mass is found a soft connective tissue very rich in irregular spindle cells and numerous small round cells. ***The very numerous cysts*** **are lined with epithelium which shows low cubical and very high narrow cells of cylindrical form in one or two layers. The walls of the cysts show at times a papillary or plaited form; the spaces communicate with each other and contain masses of mucus and thrown-off epithelium. One of these spaces shows a girdle of smooth muscle fibres passing round about the cyst. In addition to islands of cartilage and pieces of bone, many muscle bundles were present in the tumor. An acinous gland bears much resemblance to a salivary gland or pancreas. In circumscribed** spots very dark pigment was present in plenty, and covers the wall of one cavity of a diameter of one millimetre. The regular plaiting, the very constant and equal arrangement of the pigment epithelium, makes the comparison with a fetal eye very close; no part of the optic nerves or of a lens is present. If, however, the clear mosaic of the pigmented epithelial cells and their uniformly simple arrangement be taken into consideration, as well as the absence of connective-tissue substance between the cells or of branching pigment cells, then nothing remains but to parallel these pigment cells with those of the retina."

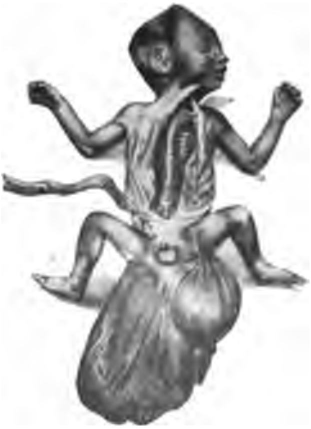

FIG. 14a

It may be further mentioned that like pigment was present in very numerous areas of the tumor, in the various masses of the tumor, and far apart from each other. A certain substance present showed a great resemblance to embryonal brain or spinal cord tissue. Kümmel says that "the parasite shut in subcutaneously presents a complete amorphus, but contains structures which, without doubt, belong to the head." Although Kümmel mentions that perhaps certain tumors of this form may be referred for their origin to the postanal or caudal intestine, yet, "because of their complicated structure, the majority of these tumors would better be reckoned with the parasitical double monstrosities" (compare Ahlfeld).

Fig. 14*a* shows this tumor. Attention is called to the fact that it was situated on the anterior surface of the sacro-coccygeal bones, that the dura of the spinal canal was completely normal, and that the tumor pushed the anus upward and under the symphysis. This position does not speak for the theory of a double monstrosity. Retina-like cells are also present.

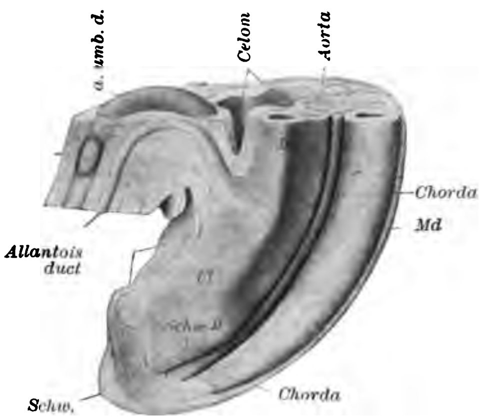

FIG. 15.

Exactly as ectoderm cells in various dermoid cysts form ciliated epithelium and epithelium with beaker cells, etc., so may we expect that pigmented cells more or less like the retina may also be present. Further, as Kümmel says, Rippmann mentioned the presence of retina epithelium in a much-discussed case of "inclusion in the cranium" with epignathus formation. It may be further remarked that this pigment was present in very numerous areas of the tumor, in the different masses, and far apart from each other.

We must, therefore, consider this tumor as originating from the caudal intestine. To explain this process I mention the following embryological facts:

In Figs. 15 and 16 it may be seen that the lower end of the intestine (*D*) forms a blindly ending sac (*Schwanz Darm*, or

Caudal Intestine), *Schw.D.*, which descends deep into the tail like end of the body. It runs *behind the anus*, which is formed later, and is called postanal or caudal intestine. In human beings it disappears, as a rule, at an early period. The caudal end of the vertebræ (*Schw.*) likewise disappears under normal conditions. At times it persists in human beings. The following statement of Keibel is of utmost importance to our explanation:

> "We may say, if we hold before our view the processes in the ventral region of the coccygeal protuberance (*Schw.*), that this coccygeal prominence is surrounded by the growth of the parts about it, and that the skin which covers it is in that way lifted off from it and used to cover these rapidly growing neighboring structures. The same process takes place about this 'coccygeal tail' as occurs to the penis in large inguinal herniæ, where the penis is robbed more and more of its skin through the decided stretching of the surrounding parts, until the penis disappears finally under the surface. It should be especially pointed out that by this withdrawal of the coccygeal prominence into the trunk also certain epithelial remnants originating from the caudal intestine may likewise be carried along. Such epithelial remnants, while they lie posteriorly to the anus at first, lie later *to the dorsal side of the rectum* and may, by the varying energies in the process of growth in which these various parts are engaged, be easily carried high up. It seems to me, in consideration of the practically important tumors of this neighborhood, especially the rectal carcinomata, to be important that these relations should be mentioned."

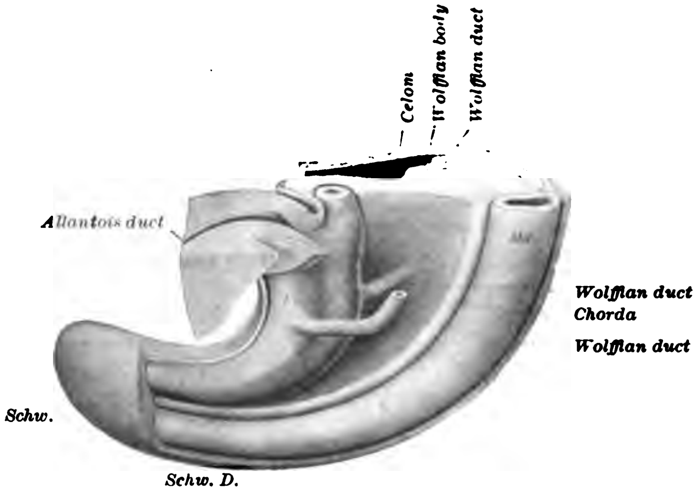

FIG. 16.

I believe that this statement fully explains the mode of development of the tumor of Kümmel, and at the same time other dermoids of this region—namely, through the dislocation of epithelial cells, with or without participation on the part of the caudal intestine. Since mesoderm cells are richly present in this region, and since remnants of this caudal gut may be left behind to greater or lesser extent, we have thereby the possibility of development of dermoid cysts of all degrees of complexity. The rôle of this caudal gut and these displaced cells is perhaps likewise evidenced by the fact that at the end of the rectum, as a rule, two forms of real diverticula, not including cyst formations, occur; according to Neumann, anal (ectodermal) and rectal (entodermal). Neumann removed an anal diverticulum which was connected with the rectum and clearly showed the type of the external skin, and at one point was united to the rectum. Here it was lined with mucous membrane. Perforating dermoid cysts in the neighborhood of the rectum may simulate diverticula.

The dermoid cysts in the region of the pelvic connective tissue form an interesting chapter. According to Sänger they are situated in the connective tissue between the rectum and the coccyx or between the rectum and the sacrum, in the connective tissue of the cavum subperitoneale, in the connective-tissue space under the cul-de-sac of Douglas, and above the septum recto-vaginale. These cysts consist of an epidermoid inner, and a connective-tissue mesodermal outer layer in simple arrangement. In three of such cases, of which Sänger has collected seventeen, were found hair, a piece of bone in only one case, which was a congenital tumor of the regio ano-coccygealis; teeth or elements of the internal blastodermic layer were not found. Sänger says "the dermoids of the bladder, rectum, and uterus have not developed genuinely in these organs, but have made their way there from cystic dermoids of the pelvic connective tissue or from dermoids of ovarian origin" (?). This last view of Sänger's is absolutely incorrect. Sänger says further: "Also real fetal inclusion would be taken into consideration for such cases as show evidences of an embryonal formation of three layers, if their origin from the ovaries or from ovarian cells can be explained only with difficulty." Sänger observes the more frequent occurrence of connective-tissue dermoids in the left half of the pelvis, and believes that this fact stands in relation to the position of the rectum toward the left side. According to our statement of Keibel's view, we may understand how, through this position of the rectum and through the participation of the caudal gut, the latter and the dislocated epithelial cells may favor the left side of the pelvis. Although this explanation makes clear the origin of certain dermoids of the pelvic connective tissue, others are in all probability dependent for their origin upon the Wolffian duct, as will be shown later. In the same way, through the Wolffian duct, the dermoids of the bladder, cervix, and vagina may be undoubtedly explained, and Sänger is mistaken when he says that these are pelvic dermoids or dermoids of the ovary which have forced their way into these organs. When Sänger further says that real fetal inclusion may be taken into consideration, for those cases "whose origin from the ovary or ovarian cells can be explained only with difficulty," he gives us another illustration of the ready use of the phrase "inclusio fetalis" for cases whose origin is not readily explained. Whether he means thereby a double monstrosity or displaced cells is not made clear in his article. Küster described a dermoid situated between the bladder and the uterus, but *in front of the peritoneum.* In this tumor were two pieces of bone. Geyl described a small teratoma of the cervix.

Sänger[1] says:

> "As is known, dermoids have been found also in the uterus, in the bladder, and in the rectum, and for these a primary location at the place of discovery has been accepted. Such tumors of the uterus have been described by Kiwisch and E. Wagner. Their authenticity has, with justice, been doubted by Gusserow. Klob mentions from the earlier literature cases by Baillie, Fabricius Hildanus, Vicq d'Azyr, which are still less authentic, as is also the case of Cousot, in which the cervix was named as the seat of the tumor. Recently a case was described by Bartlett which is nothing less than an evidence of these errors. During a forceps operation a cyst the size of a pear and filled with hair was disclosed. The patient died, and at the autopsy there was found no injury to the genitalia except a tear of the perineum. Bartlett concluded that the cyst 'was probably attached to the uterine surface.' Since, during the extraction of the shoulders, the cyst protruded in the perineal region between vulva and tuberositas ischii, it is most probable that this tumor lay in the pelvic connective tissue and was expelled through the perineal tear. Most probably in the cases of E. Wagner and Cousot, where the child's head was extracted with forceps without much force, there was likewise a rupture of the vagina or of the collum uteri with an expression of the dermoid situated in the pelvic connective tissue. In both cases convalescence was so favorable that an injury to the peritoneum can be easily excluded."

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[1] Archiv f. Gynäkologie, Bd. xxxvii.

Sänger says further:

"The dermoids of the bladder come, as a rule, from dermoid cysts of the ovary which have made their way into the bladder. There have been several cases described by Winship, Charcot, and E. Küster in which the cyst lay in the connective tissue between the uterus and the bladder; by Paget where it lay in the wall of the bladder; further, by Martini, an 'open dermoid' of the bladder in a child born with atresia ani et urethræ and which died of general peritonitis on the second day. In addition to cryptorchismus there was found absence of the left kidney, of the left ureter, and of the urethra. The posterior wall of the bladder, in which the colon ended, had the character of external skin, with hair follicles and fine hairs. Martini distinguishes: 1, purposed or accidental introduction of hair into the bladder; 2, rupture of a dermoid cyst with hair and teeth into the bladder, pilimiction; and 3, the formation of hair on the bladder mucous membrane (trichiasis vesicæ). Since he decidedly denies the possibility of hair originating from a mucous membrane, he understands under trichiasis vesicæ those anomalies of development in which a part of the bladder wall consists, in intrauterine life, through fetal inclusion, of dermoid tissue containing hair follicles and where a previous cystic form of this growth cannot be proved. There has never been observed in an adult a trichiasis vesicæ or uteri. Probably the dermoids of the bladder are always secondary and originate mostly from the ovaries (?); some, however, from the pelvic tissue.

"Characteristically, the literature makes no mention of dermoid cysts of the vagina—*i.e.*. vaginal cysts with dermoidal contents. (A dermoid of the vulva, probably an atheroma, has been described by Kirmisson.) If such tumors really occurred here primarily they would certainly not be overlooked. The paravaginal connective tissue does not belong to the vagina, but, under the levator ani, is to be considered part of the cavum ischii rectale et subcutaneum; above, the same is to be considered a part of the cavum subperitoneale pelvis. Winckel considers cases like the two of Mannel vaginal cysts, because they probably originated in the perivaginal tissue and on further growth infiltrated the vaginal wall, when they were no longer to be separated from it. They form for him a separate group, the subserous vaginal cysts, which are situated superiorly in the perivaginal connective tissue under the peritoneum; below, between the vagina and the rectum. If that be the case, then the tumor of Emmet must be considered a vaginal cyst, which certainly is incorrect. I believe, therefore, that we are not justified in ascribing to the vagina dermoid cysts and other primary cystic or solid tumors of the connective tissue which may lie near the vagina and perhaps occasionally unite with it, since they do not originate from the constituents of the vagina itself or from rudiments of organs which run in the vagina. Since the discovery of the vaginal glands, the rudiments of the canal of Gärtner, etc., the old view of Rokitansky and Scanzoni can no longer be held that 'the majority of all vaginal cysts develop in the perivaginal connective tissue and originally have nothing to do with the vagina.' The origin of certain vaginal cysts, which Thorn very acceptably explains as traumatic lymph extravasations, may well be ascribed to the pelvic connective tissue, for the reason that the largest lymph channels are found in it."

Sänger can be best answered in the words of Geyl:[1]

"Digital examination showed that a round, irregularly formed solid tumor was present up in the laquear posterius vaginæ, and that it seemed to continue into the posterior part of the cervix uteri. The diagnosis made was, vaginal tumor whose anatomical structure could not be determined without microscopical examination."

The microscopical examination showed that the surface of the tumor was composed of a cutis-like tissue and that the tumor contained fat tissue, muscle, bone, nerves, etc. Geyl made the diagnosis teratoma. In his most interesting article Geyl says further:

"In his day Friedrich Ruysch received a remarkable specimen, a dermoid cyst which, in addition to undeveloped pieces of bone, contained molar and other teeth. According to the statements of trustworthy persons, this tumor came from the stomach of Jacob Rubens, who died in the Samaranger Krankenhaus in the year 1716. It did not occur to Ruysch to doubt the correctness of this information, for sebaceous tumors, or atheromata, and their ubiquitous nature and their peculiar contents (hair, cheesy substance, teeth, and bone) were known to him from personal experience. He closes his remarks about this case as follows:

"'I would not be surprised if any one were to ask me how it can happen that all the hair follicles should be found inside of a tumor closed on every side, and especially where a fourth part of a four-footed animal supplied with a human nail may originate. Surely I can scarcely answer anything else than that the manner in which Nature works, builds, and changes is not so clear that we can state beforehand what is possible or impossible for her.'

"I read in my Dutch translation of the clinical lectures of Kiwisch: 'In another case we found on the inner surface of the uterus a cyst the size of a child's head, containing hair and teeth products.' It is not to be doubted that Kiwisch could scarcely have expressed himself more concisely, at the same time scarcely more positively, and therefore it appears to me unfair and without reason that Gusserow should seek to weaken this phenomenon by saying: 'Kiwisch's statement is too short to be proof of a phenomenon anatomically so difficult to comprehend.'

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[1] Volkmann's klinische Vorträge, No. 190.

'"It is argued against another case, described by Wagner, in which the cyst with a pedicle (Klob) appeared after a forceps delivery of the fetus, that the connection of the tumor with the endometrium was observed by the eyes of no one nor felt with the finger; further, that it could just as easily have come from another point. For this, only the supposition is necessary that *durante partu* a tear was caused through the vagina and Douglas of a length which permitted the exit of the cyst, and that afterward the pedicle was accidentally torn. Gusserow neglects to observe that then it must be granted that the accoucheur permitted the above-mentioned events to pass unnoticed. Sänger does not grant the correctness of Bartlett's view of the nature of his tumor. According to Bartlett this tumor was probably attached to the uterine surface. Sänger, to whom no other sources are open, but who takes a sceptical position with regard to uterine dermoids, considers it probable that a tumor of the pelvic connective tissue was present and that it made its way into the outer world through a tear in the perineal septum. We should, therefore, not be surprised that he accepts with approval the fact that Gusserow does not mention the cases of Baillie. Fabricius Hildanus, and Vicq d'Azyr quoted by Klob, for the older the cases the less trustworthy. The case of Cousot (to my regret the original referat is not in my hands), 'where the cervix is named as the seat,' is to them also as little genuine as the other cases and must be explained in the same way as Bartlett's case. It is clear that Sänger sees only the dermoid cysts of the pelvic connective tissue, and that Gusserow denies the existence of uterine dermoids 'because the phenomenon is anatomically difficult to comprehend.' In the *Centralblatt*, 1894. page 664, is a statement of Stewart's referred to as a dermoid cyst of the uterine wall, and I recollect that in recent years I have found other such cases described. Weak grounds, indeed, are those on which the reality of such tumors is questioned. So far as I am concerned, the quoted observations are proofs that dermoid cysts may develop out of the endometrium, and from an observation of Treub published by Schouwman it appears that the epithelium of the tube may, under circumstances, bring about the same result. A tube sac obtained by operation (the ovary of the same side was intact and free, the sac continued in that part of the tube situated near the uterus) contained fat and hair.

"The day of Cohnheim, who taught that new growths are nothing else than developed displaced embryonal cells, is past (??). Of all tumors only the teratomata or their equivalents are congenital, not the ovarian dermoids. It is said that at least their foundation must always be sought for in intra-uterine life, but this statement cannot be defended by a shadow of proof" (??).

Geyl defends in an energetic way the theory of parthenogenesis, and says finally:

"The statement which supports the possibility of growth of a non-fecundated ovarian ovum rests upon the fact, proved on many sides, that the eggs of many mammals, also those of the human being, may begin their growth within the follicle, and that they may retain this power even if removed from their place of origin—for instance, even in the tube, where they are surely under unfavorable conditions as regards nutrition. All observations which are concerned with dermoids undergoing development may be considered as proofs of this statement."

Geyl believes that this tumor in the cervix originated at the point where it was found, for "the tumor shows certain peculiarities which can only be understood upon the supposition that their presence is due to the endometritis which has visibly weakened the patient." Geyl is right; the tumor did originate at the point where it was found, but his astonishing idea that a teratoma containing so many different tissue forms developed, through a pathologically increased anaplasia, from a uterine epithelial cell, is decidedly strange and unsympathetic.

In order to show the process through which this case of Geyl, the dermoid cysts of the bladder and uterus, the case of Küster, and also some of the cases of Sänger originated, I give the following embryological illustration:

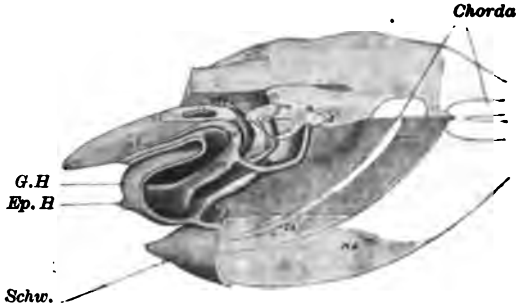

FIG. 17.—*Wf.G.*, Wolffian duct; *U*, ureter; *Schw.*, "tail"; *D*, intestine; *H*, part of subsequent bladder; *Ch*, chorda.

In the cloaca and later into the sinus urogenitalis (*sin.ug.*) empties the Wolffian duct (*Wf. G.*, Fig. 17), the excretory canal of the excretory apparatus. Ventrally to the caudal tail (*Schw.*) there occurs a depression in the membrane of the cloaca (made up of ectoderm and entoderm), which is later perforated, forming the anal opening (*Aft.*, Fig. 18). The cloaca is a short sac continued dorsally into the intestine and ventrally into the subsequent urinary bladder (Figs. 15, 16, *Cl.*). Later a decided portion of the caudal end of the intestine is reduced to a thin epithelial strand and then disappears as a rule. Mesoderm pushes the intestinal canal against the sacral vertebræ, the allantois duct (*All. G.*, Fig. 17) with the beginning of the subsequent bladder moves nearer to the abdominal wall, and there results a space between the intestinal canal (*D*) and the allantois duct (Figs. 17, 18). We then have the sinus urogenitalis, which is closed on the ventral portion of the genital prominence (*G. H.*, Fig. 17) by the cloacal membrane, which there receives the urogenital cleft. Later comes an opening for the rectum through a depression in the ectoderm (anal groove), so that the anus develops independently of the end of the intestine. We therefore see that the cloaca has been divided into a ventral canal (from which develop a part of the bladder, the urethra, and the sinus urogenitalis) and a dorsal canal (from which develops the rectum). An entodermal dividing wall has moved gradually toward the anus; mesoderm completes the division and surrounds the entodermal canals with that tissue which furnishes muscle, connective tissue, and vessels. When this dividing wall reaches the cloacal membrane we then have two completely closed and completely separated canals (Fig. 18). This division is completed by external perineal folds. These are folds of mesoderm which develop around and about the anus and which change the future ectodermal anal opening into an anal groove. This

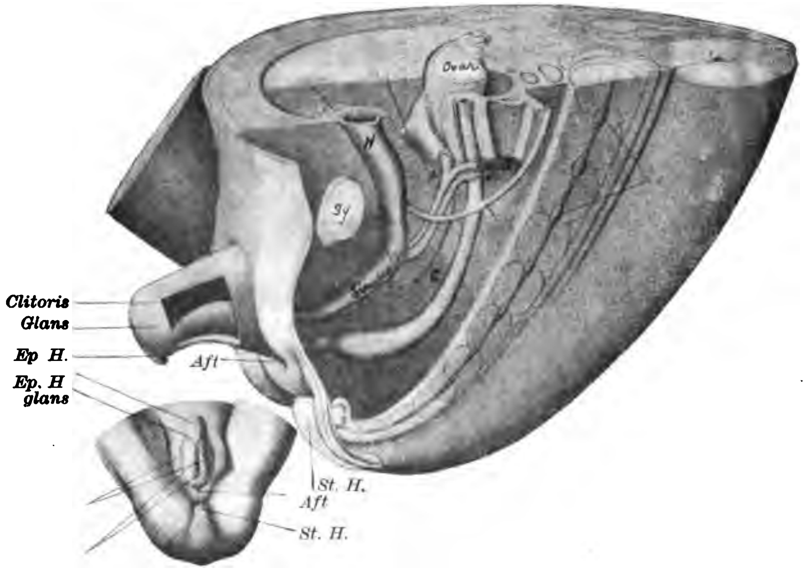

FIG. 18.

anal membrane is perforated later than the urogenital membrane.

In Fig. 19 we see the ducts of Müller and the Wolffian ducts, the ureters (*U*), and the future bladder in which they empty. The point *S* (Fig. 18) is the future hymen, so that it can be seen how the Wolffian ducts (*Wf. G.*) reach almost to the outer end of the future vagina. That part of the ducts of Müller (*Mll. G.*, Fig. 19), up to the point of bifurcation, becomes vagina, cervix, and uterus.

If the Wolffian ducts, as we shall later prove, are able to take with them ectodermal and mesodermal cells, it is evident from Fig. 19 that they may lie (1) parallel to the future uterus, cervix, and vagina, or (2) between the uterus or cervix and the bladder, or (3) between the vagina and uterus on the one hand and the intestine on the other, but always *outside of the peritoneum*—see Fig. 18, where *C* represents the fold of Douglas and where *X* represents the plica vesico-uterina. In this way may be explained a portion of Sänger's dermoids of the pelvic connective tissue, the dermoids between the bladder and the uterus (but extraperitoneal), on the cervix, in the pelvic connective tissue at the side of or in the neighborhood of the vagina, in the space of Douglas under the peritoneum, and in front of or at the side of the rectum. Fig. 20 shows these relations very clearly.

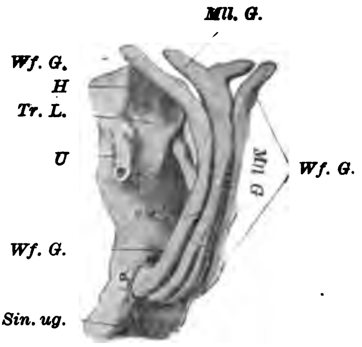

FIG. 19.

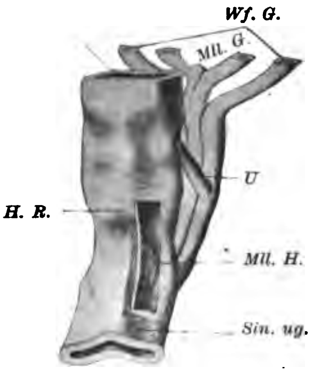

FIG. 19a.

In order to make more evident the fact that cells in varying combinations may be displaced by the Wolffian ducts, I would mention what has been stated before, that the Wolffian duct originates from the ectoderm, lies later close to the ectoderm, and continues its growth downward through the mesoderm until it reaches the cloaca, and that it is therefore in a position to carry with it into different parts of its subsequent location both ectodermal and mesodermal cells. This is further proved by the following from Wilms.[1] Wilms explains through cell dislocation on the part of the Wolffian duct the complicated vaginal tumors (rhabdomyoma sarcomatodes, sarcoma fibrosum, myofibrosarcoma with striated muscle fibres; etc.) and the mixed tumors of the cervix uteri (containing sarcomatous tissue with cartilage, striated muscle fibres, etc.). He says: "This cell dislocation is not a displacement of finished cell elements, but a removal of not yet differentiated mesoderm or mesenchym cells, which only at their future seat of development form tissues corresponding to the normal embryonal differentiation." He gives the same explanation in the case of mixed tumors of the bladder and of the vas deferens. Wilms shows the fact that mesoderm cells removed from their place of origin later on form cartilage, myxomatous tissue, etc., which they would have formed had they remained in their normal situation. Since these tumors are sarcomata, Pfannenstiel evolved the theory of metaplasia through which cartilage, etc., are formed directly from the sarcoma cells. Pick holds the same idea. That this view is incorrect, that it causes confusion in the groundwork of pathology, and that it takes us far from the great truths contained in the theory of Cohnheim is not to be doubted. We likewise see how unstable would be our pathological views if we were compelled to accept the explanation which Geyl gave for his teratoma of the cervix. Just as in these mixed tumors only mesoderm cells are dislo-

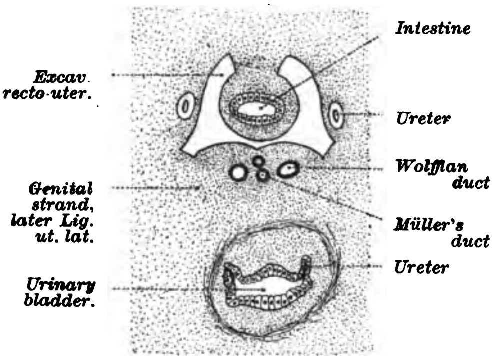

FIG. 20.—Genital strand. Human embryo of nine weeks. Transverse section. After Kollmann.

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[1] "Mixed Tumors," vol. ii.

cated, forming sarcomatous tumors of the vagina, cervix, and vas deferens, etc., so likewise can ectoderm cells be removed, and we would then have an explanation for the occurrence of dermoid cysts in these places. According to Englisch those different cysts which occur in the posterior wall of the bladder, especially in the connective tissue between the bladder and the rectum, originate as a rule from remnants of embryonal structures, from the Wolffian body and the ducts of Müller, or through cystic dilatations of the seminal vesicles and the sinus prostaticus. Bryant finds dermoid cysts in the region of the bladder to be rare, and explains them through an inclusion of dermoid cells. In the case of Martini, the posterior wall of the bladder had the character of the external skin and was covered with hair follicles and hair (trichiasis vesicæ).

Some of the cases which Sänger considers to be dermoids of the pelvic connective tissue Winckel considers to be dermoids of the vagina, because they originated in the perivaginal connective tissue. These may, in consideration of the course of the ducts of Wolff, be certainly classed as dermoid cysts of the paravaginal tissue, just as certain vaginal cysts result from rests of the Wolffian duct. The latter may be explained as follows: During the development of the ducts of Müller the Wolffian ducts become rudimentary. Often the proximal and the distal ends remain; at other times the entire duct disappears. According to Kollmann it is present, at the side of the uterus, as an indistinct structure in the human female fetus in about every third case, with or without epithelium. The lower end remains, as a rule, along the cervix, but only visible in transverse sections.

Walzberg-König and Biernacki maintain that the dermoid cysts of the pelvic connective tissue are of ovarian origin. Sänger proves this view to be false for the following reasons:

> " 1. The location, the extent, the structure and growth are entirely different from the intraligamentous and subperitoneal cysts of the ovaries, of which only the proliferating cysts of the ovary and of the parovarium are here considered. Their universal situation in the pelvic connective tissue, the thin walls of these dermoids, which usually are unilocular, the characteristic displacement of the rectum, the vagina, the uterus, and the levator ani, and their growth downward toward the perineum, are typical. 2. A connection of dermoids of the pelvic connective tissue with the ovary has not been proved clinically or anatomically. 3. A dermoid cyst of the ovary which has developed entirely intraligamentally or subperitoneally has not been described (?).

"Such a connection is as little necessary in explaining the origin of dermoids in the pelvic connective tissue as, for instance, would be needed in the case of dermoids of the orbita or the lungs. The unilocular, smooth, thin-walled dermoids containing little or no hair, especially those of the deeper and lateral portions of the pelvic connective tissue, are best explained as embryonal inversions of ectoderm." (But how and where, Sanger does not say.)

Küster, who described a properitoneal dermoid between the bladder and the uterus, found therein two pieces of bone. He observes that one may be "considered without hesitancy as a rib, which is united to the wall by a firm band"; of the other he says: "The other is a flat bone which I cannot positively identify, probably a pelvic bone." It may be observed how a piece of bone, without proof and perhaps through a distant external resemblance, is called a rib, and the other a pelvic bone. As a result of this description we frequently meet with the statement that in ovarian dermoids (?) ribs and pelvic bones have been found, for it was taken for granted that this dermoid originated in the ovary and made its way between uterus and bladder. Küster says that only one other case has been reported in which a properitoneal dermoid was found in the same place (Nélaton). As a result of the above explanations I would recall the fact that, in spite of the view of Sänger, the dermoids of the bladder, cervix, and rectum have really originated in these organs and have not made their way into these situations from the ovary or from the pelvic connective tissue. We see further how easily a fetal inclusion is taken for granted as soon as the exact mode of origin is not clear. We see, finally, that all these latter cases are not difficult to explain if the complicated embryonal processes are closely studied. So far we have discussed the dermoids occurring in nearly all parts of the body, with the exception of the dermoids and teratomata of the ovary and testicle, with which, however, the following portion of this work is concerned. If we group together the cases so far quoted with their contents we have the following:

Dermoid of the hypophysis duct (Breslau and Rindfleisch).—Called "fetus in fetu." Contained, according to description, eyes, several extremities, cartilage, bone, muscle, nerves, glandular substance, intestine-like glands.

Dermoid of the sella turcica (Beck).—Explained by Beck as the result of displaced cells. Contained fourteen *teeth*, bone, cavities lined with ciliated epithelium, etc.

Dermoid behind the eye (Weigert).—Described as "fetus in fetu." Contained cartilage, bone, mucous-gland cysts, "intestinal" structure, bronchial elements, glands of the form of the glands of Lieberkühn, groups of lymphoid cells, cysts with stratified ciliated epithelium, etc.

Retroperitoneal dermoid (Marchand) (considered by Wilms to have originated from the Wolffian duct).—Described as "fetus in fetu." Contained cysts with ciliated epithelium, mucous membrane of the character of the mucous membrane of the large intestine, cranium, "prostate," intestine, and glia tissue.

Retroperitoneal dermoid (Bardenheuer).—Contained *teeth,* hair, and bone.

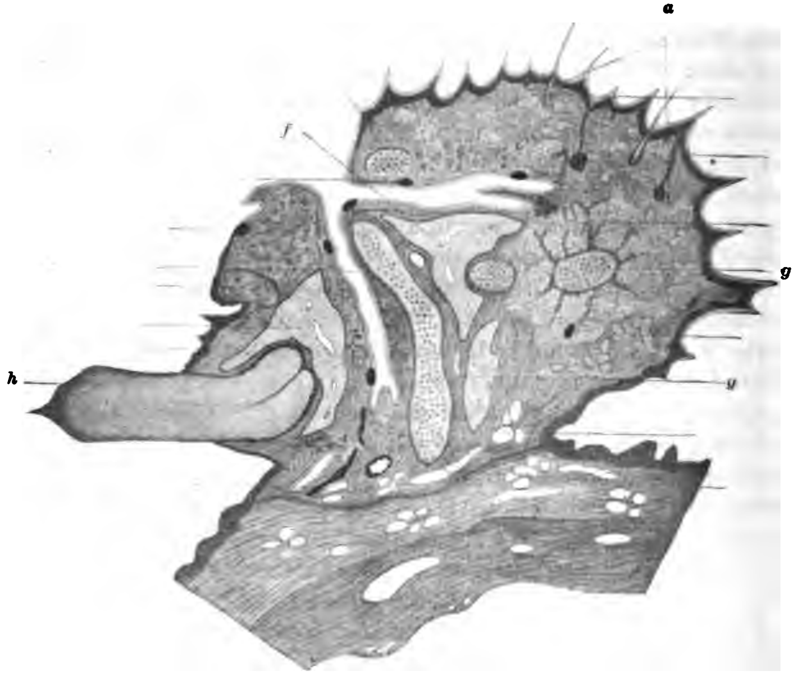

FIG. 21.

Dermoid in the region of the liver and stomach (Bonfigli).—Contained bone in which were firmly fixed two *teeth,* nineteen molar *teeth* free in the cavity, cysts filled with mucus.

Omental dermoid (Pommer).—Contained joint-like structures covered with skin, retina-like cells, *teeth,* "appendix."

Dermoid on the anterior surface of the sacro-coccygeal bone (Kümmel).—Contained bone, cartilage, *tooth* formation, mucous cysts, retina-like cells, muscle fibres.

Cervix teratoma (Geyl).—Contained bone, muscle fibres, nerves, etc.

All these dermoids are undoubtedly to be explained through a displacement of cells, and this process has been supported by our embryological discussion. We have in dermoids of the ovary the same elements, yet, as regards these tumors, writers have gone further and have described structures resembling the eye, maxillæ, extremities, parts of intestine, trachea, mamma, etc., which views rest on the same foundation as those heretofore criticised, viz., imagination and far-fetched resemblance. Here the same mistakes have been made as in the above-mentioned cases.

If we are able to prove embryologically a possibility that displaced cells, carried into or near to the ovary, are the cause of these tumors, we will then have an explanation which is in harmony with the explanations given for the above-mentioned cases. That this is, beyond any doubt, the case as regards ovarian dermoids, the following work will prove. In addition we shall explain at the same time the origin of most of the other ovarian tumors, cystic or solid.

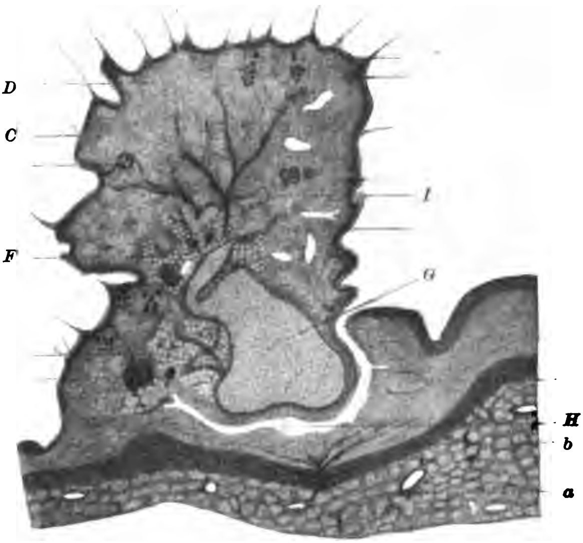

FIG. 22.—Prominence on the inner surface of a dermoid cyst of the mediastinum. Separated from the lung (*a*) by a membrane (*b*) adherent to the pleura. *C*, normal cutis with hair; *D*, sebaceous glands; *F*, fatty tissue; *G*, hyaline cartilage; *H*, canal with ciliated epithelium; *I*, nerves.

At any rate, the dermoid cysts of the ovary form no specific group. We find on the inner surface of these cysts a prominence whose base is formed by the tissue of the ovary. In this prominence are found sebaceous glands (*a*, Fig. 21), hair, cartilage, bone (*g*), glands lined with squamous epithelium, with cylinder epithelium, with ciliated epithelium; also teeth (*h*), glia tissue (*f*), lymph-adenoid tissue, etc., as may be seen in Fig. 21 from Wilms.

The same prominence occurs in other dermoids, as Fig. 22, from Wilms, a prominence in a mediastinal dermoid, proves.

We have already seen in Fig. 10 how the Wolffian body and the Wolffian duct are in a position to cause not only mixed tumors of the kidney, but also retroperitoneal and omental dermoids; and Wilms grants that the case of Marchand is not a fetus in fetu, but, as we have shown, is due to the ectodermal origin of the Wolffian duct. How easy it should be in the same way to explain the origin of dermoid cysts of the ovary, for the ovary later develops at that point at which the Wolffian duct and the Wolffian body developed, and the Wolffian body takes part in the formation of the ovary and lies later in the ligamentum latum as the parovarium and the paroöphoron, not alone at the hilus of the ovary, but also sends some of its canals through the hilus into the ovarian tissue. We discuss, then, these embryological facts, as well as the origin of the cysts of the ovary, especially the cystomata pseudomucinosa which are often found with dermoid cysts in the same or in the other ovary.

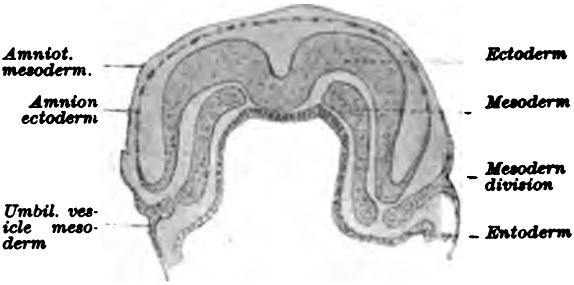

FIG. 23.—Middle blastodermic layer of a human embryo, still without primary vertebræ and chorda. Transverse section. After Keibel.

The following processes, which I have studied in the specimens of Prof. Spee, have been put together, for the sake of clearness, by consulting the text books of Kollmann, Hertwig, and Nagel, since I shall later explain some important fundamental views which differ from these. These processes show the extremely interesting and, for our theory, weighty changes in the urogenital system during embryonal life. We find at first the formation of the head-kidney, or pronephros, with its excretory duct, giving way later to the formation of the primary kidney with the same excretory duct. Both are replaced by the permanent kidney. We shall then discuss the duct of Müller and then the ovary.

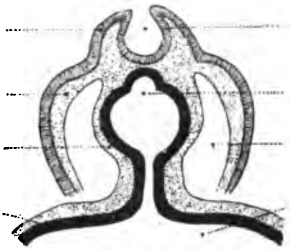

FIG. 24.—Animal and vegetative canals. Schematic development. After Kollmann.

The head-kidney disappears and only slight evidences are found in the human being.

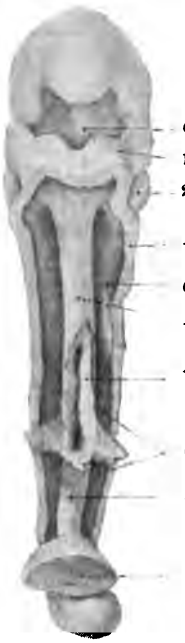

FIG. 25.—Human embryo 2.4 millimetres long, with heart and umbilical vesicle removed and umbilical pedicle cut. Reconstruction. After His.

The primary kidney leaves rests behind, the parovarium (the epididymis in man) or epoöphoron, and the paroöphoron (parepididymis), and also parovarial formations.

The ducts of Müller form the uterus and tubes (minute explanation is given later).

Fig. 23 shows the middle blastodermic layer of a human embryo still without primary vertebræ and without chorda (transverse section after Keibel).

Through the division of the mesoderm there is formed a parietal and a visceral layer, which results in the formation of a symmetrical space (celom). These two layers or folds approach each other in the anterior median line and form the cylindrical body shape through the closure of the intestinal canal and the abdominal wall.

This space in the embryonal body is intended to accommodate the internal organs and is called "the celom." From this celom are formed three divisions: (1) the primitive pericardial space; (2) the symmetrical pleural spaces; (3) the abdominal cavity. .

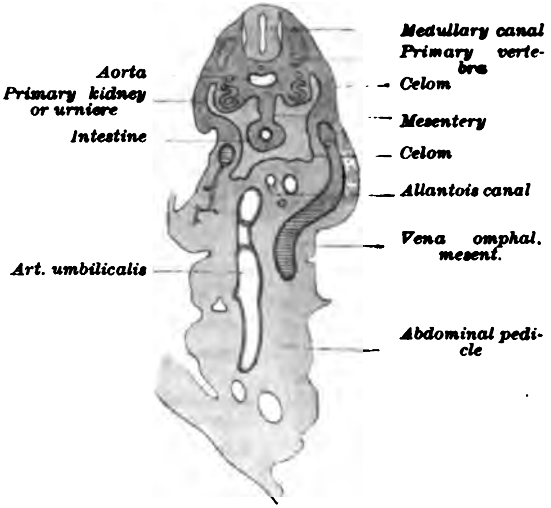

FIG. 26.—Human embryo 5 millimetres long. After His. The section includes the umbilical pedicle also.

The celom wall (the parietal layer of the mesoderm, Fig. 25) consists of mesoderm from which develop connective-tissue elements and involuntary pale muscle fibres. Externally it is covered by ectoderm, and internally by the celom epithelium, which is formed of mesoderm cells. The visceral layer of the mesoderm covers on the posterior body wall the entire intestinal canal (Figs. 24 and 25), forms the primary mesentery (Fig. 26), the mesenterium commune, and furnishes the muscle layers of the intestinal system and the connective-tissue cells and muscle cells of the mucosa. It is lined within by the entoderm of the glandular layer, and is covered externally by the celom epithelium (Figs. 24 and 26). The celom epithelium is, as we shall see later, the location for the development of the generative organs.

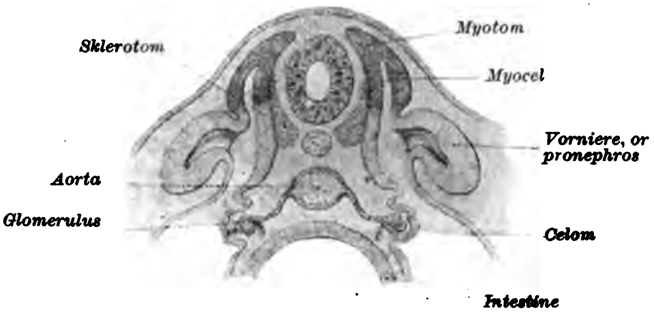

FIG. 27.—Transverse section in the region of the pronephros or vorniere (ichthyophis gut). After Semon.

In the parietal mesoderm (Fig. 27), where the segmented portion goes over into the unsegmented portion of the middle blastodermic membrane, the pronephros, or head-kidney, is formed. It consists of canals which stand in communication with the celom. These are called diverticula. The opening into the celom receives a ciliated, funnel-shaped character, so that every diverticulum becomes a kidney tubule resembling that in Fig. 28.

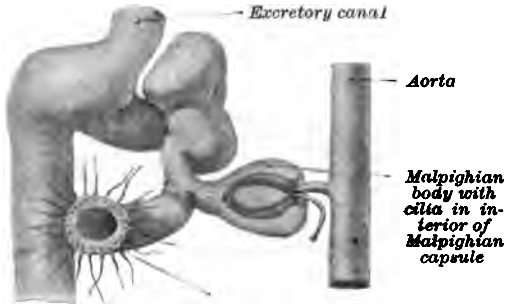
Excretory canal
Aorta
Malpighian body with cilia in interior of Malpighian capsule

FIG. 28.—Nephridium of an amphibium (ichthyophis gut). After Semon. To the left is the excretory canal, into which empties the segmental canal.

At their peripheral end the diverticula unite into a common canal which lies close to the ectoderm, as Figs. 29 and 30, of a later stage, show.

This common canal (the excretory duct, the Wolffian duct) lies between epidermis and the parietal mesoderm.

It extends over several body segments, and is in this way united or connected with the abdominal cavity by several consecutive openings or head-kidney funnels. The tubules lie in the neighborhood of the aorta. Laterally, to the right and left of the primary intestine, develops the Malpighian capsule (Fig. 26).

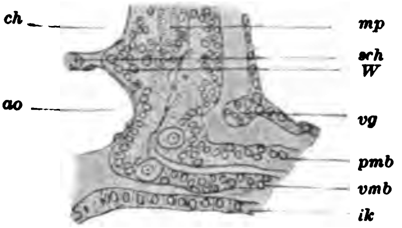

FIG. 29.—Transverse section through an embryo of Pristiurus. After Rabl. *ch*, chorda; *mp*, muscle plate of the primary segment; *w*, skeletal tissue which has grown out from the medial wall of the primary segment; *ao*, aorta; *ik*, entoderm; *pmb*, *vmb*, parietal, visceral mesoderm; *vg*, *duct of pronephros.*

Into each of these a branch from the aorta makes its way and extends into capillaries, as in the Malpighian bodies in the permanent kidney. Finally the Malpighian body is united with these kidney tubules, whereby a branch of the tubule with its ciliated funnel (Fig. 28) surrounds the vessel and its covering and a small portion of the celom. This vessel-knot develops in the wall of the abdominal cavity. The common

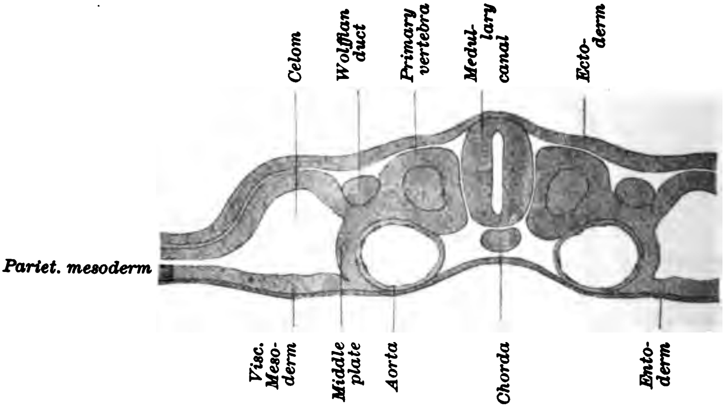

FIG. 30.—Embryo of bird with four blastodermic layers, at beginning of third day. Transverse section.

canal is later the excretory duct of the primary kidney and is called "the Wolffian duct." It grows gradually through increase of its own cells, and extends so far that it eventually opens into the cloaca, becoming in its course more and more separated from the ectoderm. It is not definitely decided (?) whether, at the point of union between the Wolffian duct and the ectoderm, cells of the ectoderm are furnished to the Wolffian duct, or whether the material for the duct comes from the mesoblastic primary kidney formation itself as it continues its growth posteriorly. Concerning the development of this duct. it must be mentioned here that Prof. Spee believes that *not only does the Wolffian duct stand in close relation to the ectoderm, but that it originates from the ectoderm.*

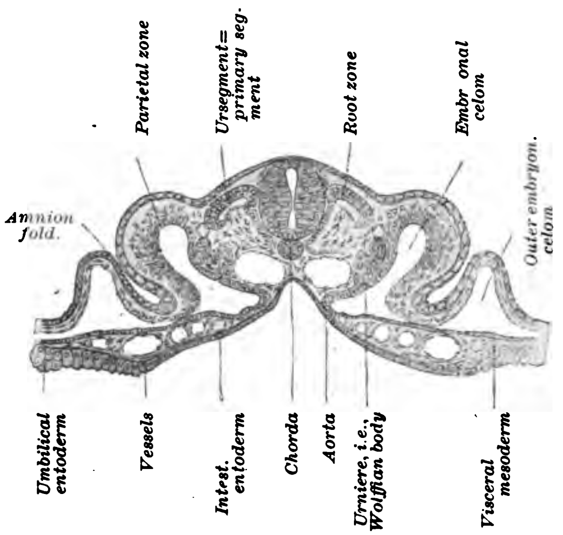

FIG. 31.—Transverse section through an embryo chicken with twenty-four primary segments. After Balfour.

The pronephros is retained in certain fishes. In amphibia it disappears; in the amniotæ evidences have been found. In mammals evidences have been found in rabbits, and evidences of its existence are claimed to exist in man. In amphioxus a pronephros has been shown which begins in the abdominal cavity and extends to the branchial space, *i.e.*, empties externally. Since the nephridia of the invertebrates open upon the skin, it is quite probable that the above-mentioned contact between the Wolffian duct and ectoderm *is an evidence of this old arrangement.*

Rückert and Felix believe that the pronephros phylogenetically was originally composed of segmental tubules, which extended *directly from the abdominal cavity to the external skin.*

The Primary Kidney (*Wolffian Body*).—Shortly after the formation of the pronephros in animals where the pronephros is only rudimentary, the primary kidney develops.

The primary kidney lies retroperitoneal and to the side of the vertebræ. Its surface looks toward the celom; to the median side it borders on the aorta; dorsally is the posterior abdominal wall. It lies directly posterior to the pronephritic tubules near the following section of the excretory duct. Its lower end extends into the pelvis, its upper end up to the heart.

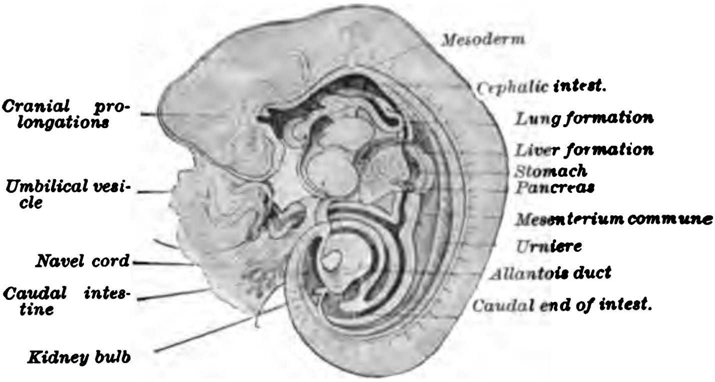

FIG. 32.—Human embryo, 5 millimetres long. Reconstruction. After His. Enlarged 10 ×.

The development of the primary kidney tubules stands in close relation to the development of the primary segments (Figs. 31 and 33).

When the "primary segments" begin to be distinctly marked off from the "lateral plates," there develops at this point of separation a thin band, which for a certain time furnishes the connection between these two parts. This point where these consecutive bands, which appear like cell masses placed between the "primary segment" and the "lateral plate," appear, is called "the middle plate," and, because of its relation to the primary kidney tubules, *urnierenblastem.* The duct of the primary kidney is seen to make its way close to the connecting bands of the primary segments and lateral to them.

Each connecting band which forms a primary kidney tubule is called by Rückert nepthrotom. The remaining portion of a "primary segment" forms the muscle plate (myotom) and furnishes the cell material for the skeletal tissue (sklerotom). While one end of the primary kidney tubule remains united to the abdominal cavity, the other end unites with the excretory duct and opens into it. In this way the excretory duct of the primary kidney and the tubules of the primary kidney have developed separately and have united by secondary junction.

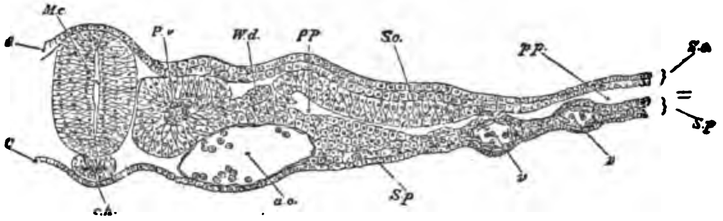

FIG. 33.—Transverse section through the dorsal region of an embryo chick of forty-five hours. After Balfour. The mesoderm is partly divided into primary segments (*P.v*) and the lateral plate which includes the abdominal space (*p p.*) *M.c.*, medullary canal; *P.v.*, primary segment; *S.o.*, body plate; *S.p.*, intestinal plate; *p p.*, abdominal space; *c.h.*, chorda; *A*, ectoderm; *C*, entoderm; *ao*, aorta; *v*, blood vessels; *W.d.*, Wolffian duct.

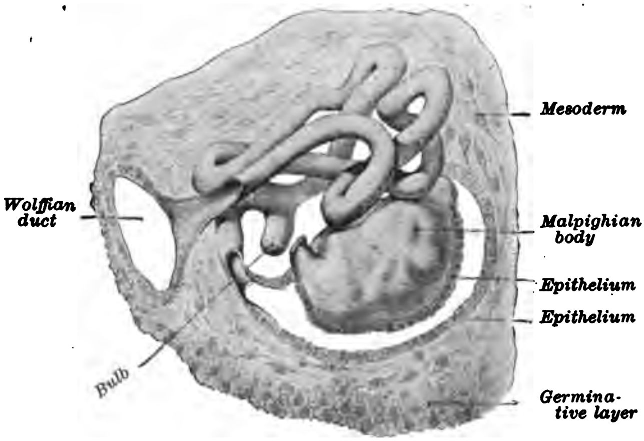

FIG. 34.—Urniere tubules, combined drawing. Human embryo, 10.2 millimetres long. After Kollmann.

Fig. 34 shows a primary kidney tubule, one of this series of excretory tubules of the form of twisted kidney tubules, of which the primary kidney is composed. All these structures are embedded in mesoderm. On the primary kidney lies *the generative fold,* which belongs to the peritoneum parietale, which lies near the primary kidney. The peritoneum at this stage consists only of cells.

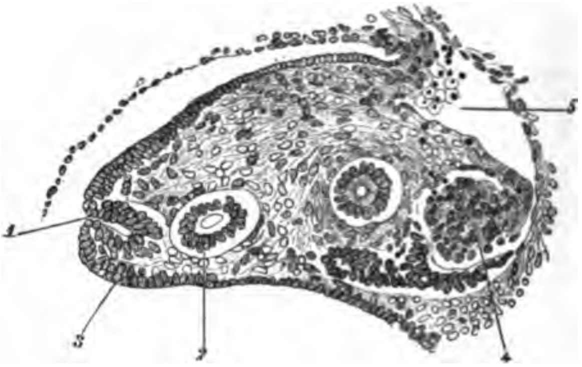

FIG. 35.—Transverse section through the upper end of the Wolffian body of a female embryo 12 millimetres long (Nagel). Formation of the duct of Müller. 1, duct of Müller; 2, Wolffian duct; 3, celom epithelium of the urniere; 4, glomerulus of the urniere; 5, blood vessel. Urniere = Wolffian body or primary kidney.

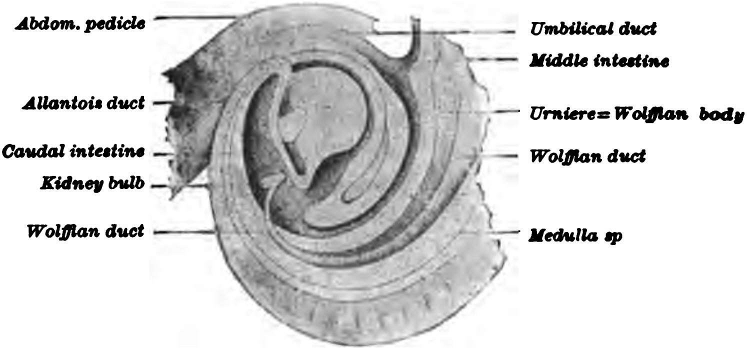

FIG. 36.—Posterior body end of a human embryo 5 millimetres long, with the caudal end of the intestine and the "caudal intestine" at their height of development. After His.

The upper half of the primary kidney is called "the cephalic" portion, the lower half is called "the caudal portion." The Wolffian duct, which has extended downward through the mesoderm, empties into the cloaca, later into the sinus urogenitalis.

The Ducts of Müller.—The duct of Müller originates from the celom epithelium on the outer side of the Wolffian body (Fig. 35). It begins as a short depression, open above, with a solid pointed end, and lies close to the Wolffian duct until it reaches the sinus urogenitalis. It is claimed by some that the duct of Müller is formed partly by division from the Wolffian duct.

The duct of Müller and the Wolffian duct are surrounded by a common tissue structure and form the so-called "sexual band." Occasionally the process of inversion of the celom epithelium which forms the tube is repeated, and a short *accessory tube* is found, which, as a rule, consists of a more or less distinct fimbrian end in the neighborhood of the abdominal opening of the tube. These are to be distinguished from the accessory openings in the tubal canal itself. They may have occurred through an irregular inversion in the formation of the original funnel-shape depression (Fig. 35). The occurrence of openings further away in the course of the tube may also be explained by changes in embryonal development, for it may be considered that a union between the epithelium of the duct of Müller and the epithelium of the Wolffian body occurs at one or more points—a fact which, perhaps correctly, has

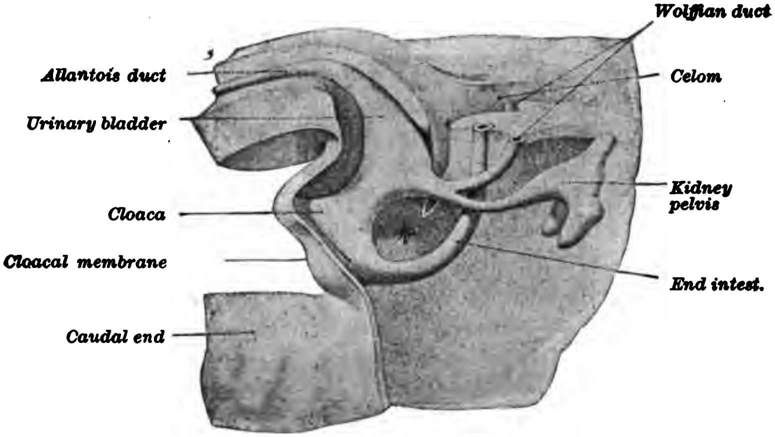

FIG. 37.—Pelvic end, human embryo 11.5 millimetres long (4½ weeks). After Keibel. * Septum uro-rectale.

given rise to the theory of the development of the duct of Müller from the Wolffian duct. Then these accessory openings occur through subsequent thinning and perforation of the tube wall with prolapse of the mucous lining at these points. In the wall of such tubes thin areas are found which are protruded outward and permit the mucous membrane to be recognized.

The Kidney.—In Fig. 36 it is seen that at the end of the Wolffian duct an extension is formed from its posterior wall, the kidney bulb. From this comes the ureter.

It grows forward and is enclosed in a tissue rich in cells, the kidney mesenchym, which furnishes the connective-tissue elements of the kidney. The ureter dilates at its blind end and furnishes the pelvis of the kidney.

From it develop the kidney calices, and from these, through further development and division, the kidney tubules. According to certain authors, the canal system of the kidney is developed from the ureter according to the usual glandular growth. According to other authors, the kidney develops from two separate formations, the medullary substance with its collecting tubules from the ureter, the cortical substance and the twisted tubules and the loops of Henle from a special formation, the kidney "blastem." The latter view corresponds to the development of the primary kidney in so far as in the latter the excretory duct and the tubules develop independently and secondarily unite. Kollmann says that "the mesoderm (?) furnishes the excretory apparatus with its pronephros and the primary kidney, the testicle or ovary and their epithelia. In this apparatus there is found in two places *a minimal cell invasion* on the part of the adjoining layers: in the beginning during the formation of the Wolffian duct (from the ectoderm), and later on in the formation of the permanent kidney (from ectoderm). The majority of cells, especially the generative cells, which are intended for the propagation of the species, originate, however, from the mesoderm" (?).

Ovary.—In Fig. 38 it is seen that at one point of the celom epithelium the germinal epithelium develops on the inner surface of the Wolffian body and is sharply marked off from the stroma of the latter.

Through decided increase of the germinative epithelia and the change of a large portion of them into primary ova, the parenchymatous ovary is formed. Connective-tissue cells and vessel branches penetrate *into the germinative epithelium from the stroma of the Wolffian body* and divide it into compartments. These compartments consist of primary ova and germinative epithelia, and are divided into constantly smaller compartments by the growing connective-tissue stroma.

Finally we have primary ova surrounded by a layer of germinative epithelium, the so-called "primary follicles." The superficial layer of the germinative epithelium remains as a simple cylindrical layer of epithelium covering the ovary.

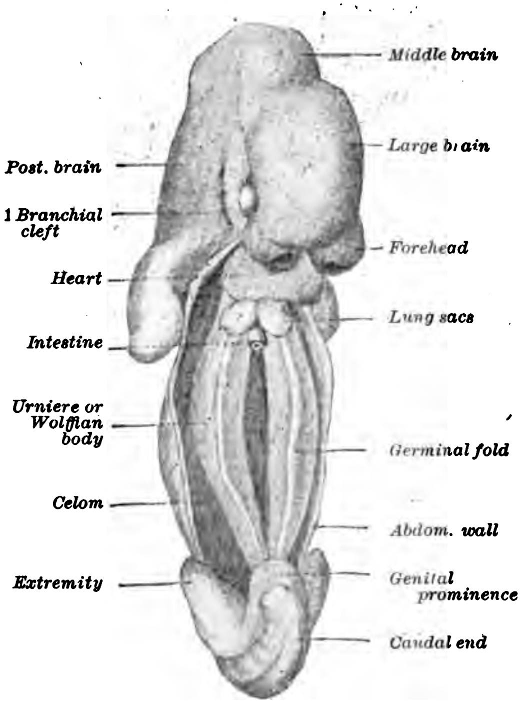

FIG. 38.—Human embryo in the fifth week, the anterior body wall removed, the urniere exposed. After Kollmann.

Nagel and most authorities believe with Waldeyer that *derivatives of the germinative epithelium form the follicle epithelium.*

Kölliker, Rouget, etc., say that the follicle epithelium develops from cells which may be traced back to the tubules of the primary kidney which send cell prolongations into the ovary.

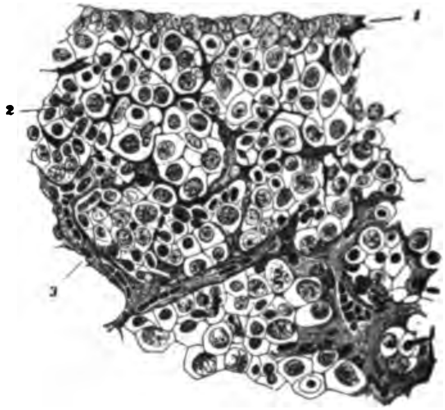

FIG. 39.—Section through the ovary of a human embryo with a body length of 11 centimetres. After Nagel. 1, external layer of the primitive ovary (later the germinal epithelium of the ovary); 2, compartments of ova; 3, stroma (vessels).

Foulis says that the follicle epithelium originates from connective-tissue cells through cell division and cell increase.

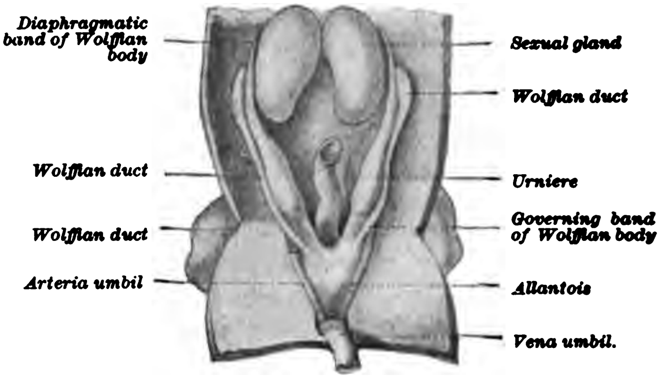

FIG. 40.—Germinative gland of a human embryo 40 days old. Two branchial clefts are still open. After Kollmann.

Wendeler says that the follicle epithelium comes from the connective-tissue stroma of the ovarian formation, and agrees with Foulis.

On the fortieth day the relations are as seen in Figs. 40 and 41.

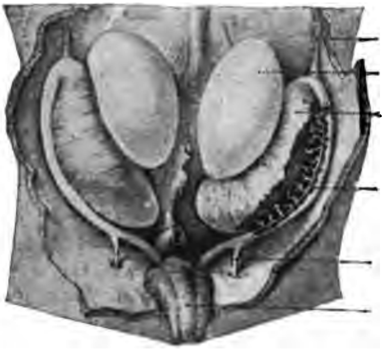

FIG. 41.—Urniere and generative gland. Human embryo 17 millimetres long at the beginning of the sixth week. To the right the Wolffian duct is opened. After Kollmann. Enlarged 15 ×.

In the beginning of the third month the relations are as seen in Fig. 41a.

During the development of the duct of Müller the Wolffian duct becomes rudimentary; often the proximal and distal ends remain, at times they disappear entirely. In the human fetus of the female sex it is found as an indistinct structure,

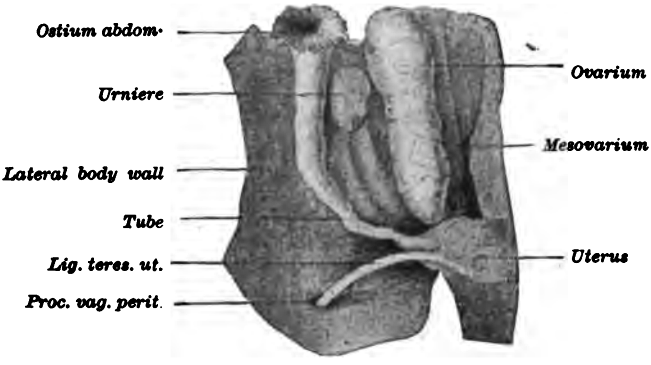

FIG. 41a.—Tube, uterus, and ovary of the right side. Beginning of third month. After a fresh specimen. After Kollmann.

with or without epithelium, at the side of the uterus, in every third case. The end remains, as a rule, along the internal os, and may be seen in transverse sections.

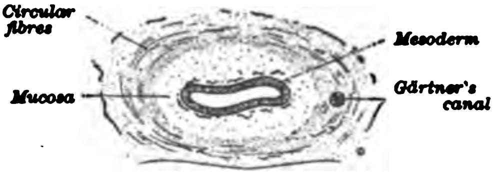

FIG. 42.—Sexual band. Transverse section through the uterus. One-half the natural size. After Tourneux. 10.5 centimetres from head to coccyx.

In the development of the ovary there go out from the germinative epithelium thinner and thicker cell bands, the so-called "tubules of Pflüger." In these tubes are found follicle

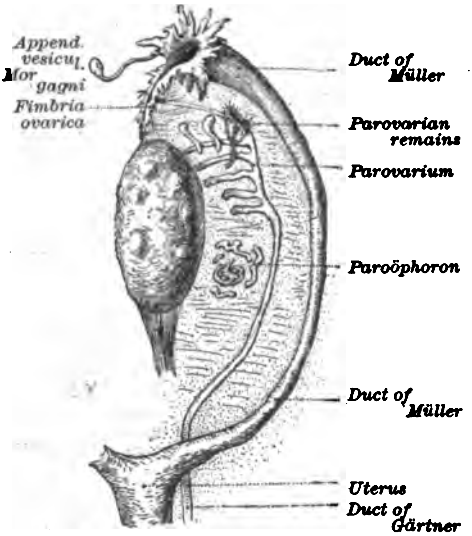

FIG. 43.—Relation of the Wolffian duct and ducts of Müller in female embryo. Schematic. After Kollmann.

cells and primary ova. Waldeyer says "that in the second year the formation of new ova can no longer be demonstrated."

The epithelial prolongations which grow out of the Wolffian body into the ovary, and which penetrate the ovary, are the so-called "sexual bands" of the primary kidney; they originate from the epithelium of the Malpighian bodies and grow toward the "tubes of Pflüger." From the latter develops the cortex of the ovary; the former take part in the formation of the medullary portion and are called "medullary bands."

According to Nagel, those connective-tissue cells which divide the germinative glands into compartments originate from the stroma of the Wolffian body without participation of the Wolffian canals.

Fig. 43 shows the relations after complete development.

The parovarium (epoöphoron) results from the cephalic end of the primary kidney. It consists, in a fetus of nine centimetres, of a portion of the Wolffian duct and ten to fifteen transversely running tubules (epididymis in man).

In the newly-born it is easily found. In the developed female it is found with difficulty or is absent.

The paroöphoron lies distal to the parovarium. It originates from the caudal end of the primary kidney and consists of small twisted tubules lined with ciliated epithelium and disappearing vessel knots (parepididymis in man).

In man the testicle receives its specific tissue elements directly from the germinative epithelium. This epithelium furnishes the primary seminal cells. The tubules which grow from the primary kidney into the testicular formation (the sexual bands) furnish an outlet to the semen, so that the seminal tubules, the tubuli seminiferi, originate from the germinative epithelium, the tubuli recti and rete testis from the primary kidney. The Wolffian duct forms the vas deferens. The cephalic portion of the primary kidney forms, as has been said, the rete testis, the tubuli recti, the epididymis—*i.e.*, the head of the epididymis. The tail of the epididymis is formed from the beginning portion of the vas deferens.

The lower end of the primary kidney disappears. There are found in older embryos, between the vas deferens and the testicle, for a long time small twisting tubules, between which disappearing Malpighian bodies occur, and the whole forms a small yellow body. In adults these remains are small; they furnish the vasa aberrantia of the epididymis and the paradidymis of Giraldés. The ducts of Müller disappear in man as meaningless structures. In their middle portion they disappear almost entirely, but during embryonal life they are present as epithelial strands.

The lower ends of the ducts of Müller become the uterus masculinus, the separating wall disappears, and they unite into a small tube which lies between the outlet of the vasa deferentia and the prostate. They are called "sinus prostaticus" and correspond to the vagina.

The upper ends of the ducts of Müller may form hydatids, small vesicles which are found upon the epididymis and are lined with ciliated cylindrical epithelium, and may continue into a small ciliated duct. At one point they possess a cyst-like opening. As in man, from the epididymis, tubules grow in the substance of the testicle, forming the rete testis and the tubuli recti, so, in the female, tubules pass out from the parovarium into the medullary substance of the ovary and form the medullary bands. The anterior end of the duct of Müller, which in the embryo is situated very far forward, seems in the female to disappear and the permanent opening probably develops anew. This disappearing portion forms, perhaps, the hydatids of Morgagni, small vesicles which are united by a longer or shorter pedicle to a fringe of the abdominal end of the tube.

Parovarian remnants occur, as a rule, on the anterior layer of the ligamentum latum above the enclosed parovarium. There are found funnel-shaped pedunculated growths with the opening toward the abdominal cavity and furnished with ciliated epithelium. Two funnel-shaped openings with one pedicle also occur. Cystic remnants corresponding in position, size, and form also occur, but in place of the funnel-shaped opening a cyst is present, which is always lined with ciliated epithelium (Kollmann).

Grape-like growths also occur. In structure they are like the above-mentioned forms, but at the free edge is found a dilatation lined with ciliated epithelium.

All these show a remarkable resemblance to the funnel-shaped remnants and the pedunculated hydatids found in the epididymis. These remnants are to be considered embryonal rests. They are probably an old inheritance, *remains of multiple segmental communications between the primary kidney and the celom* (Kollmann).

Tubo-parovarian canal is a rudimentary canal passing off from the parovarium and lined with ciliated epithelium, which opens in the end portion of the tube or more frequently upon the fimbria ovarica.

A similar canal occurs which, however, does not open on the fimbria ovarica. It may be considered as a rest of the Wolffian duct. At the opening of the tube there is often a cystic vesicle, a hydatid of Morgagni. It is a question whether it comes from the tubules of the primary kidney or from the anterior end of the duct of Müller. In the disappearance of first formation of the latter such a hydatid might be formed, but then a new tube opening would have to be created.

Nagel says that the main canal of the parovarium runs parallel to the tube, and that it ends blindly in its upper end, at times in a small cyst, the hydatid of Morgagni; that toward the median line it may be followed as the duct of Gärtner up to the uterus. At times remains of it are present in the lateral walls of the body of the uterus and the cervix, and, rarely perhaps, in the upper part of the vagina. The tubules lie close together toward the ovary, ending, as a rule, blindly at the hilus, but at times they pass on, as has also been found in adults, into the zona vasculosa ovarii.

De Sinéty and Flaischlen have found in apparently normal ovaries of individuals, in whom the other or even the same ovary was changed to a cystoma, that *the surface epithelium of the ovary was ciliated;* normally such a condition could not exist (Nagel).

The ligamenta lata embryologically represent the epithelial covering (celom epithelium) and the connective-tissue basis of the Wolffian body.

Ovarian Cystomata.—Wendeler says that the cells which are the cause of the epithelial tumors of the ovary may be either the surface epithelium, the follicle epithelium, or the medullary strands. The latter are tubular rudiments of the Wolffian canals, penetrating to a greater or lesser extent into the hilus of the ovary.

To explain the origin of cystadenomata of the ovary, these epithelial cells have by different authors been differently considered as the cause.

Klebs believes that the cystadenoma glandulare develops from the tubules of Pflüger in the fetal or child's ovary, with later development at puberty.

Waldeyer believes that it originates from the tubules and compartments of ova from which the Graafian follicle develops. This occurs either in the early years or later from tubules which are abnormally developed from the germinal epithelium.

Olshausen believes that cystadenoma papillare develops from the parovarium, because it contains ciliated epithelium and may develop intraligamentally.

Von Kölliker believes that it originates from the membrana granulosa of the follicles; he considers this follicle layer to be a derivative of the medullary strands and therefore of the parovarium.

Marchand says that it originates from the Graafian follicle or from structures which are equivalent and which probably come from the surface epithelium of the lateral walls of the ovary.

Flaischlen considers that it originates from the germinal epithelium.

Velits believes the Graafian follicle to be the point of development.

Nagel believes that they originate from the germinal epithelium and *never from the follicle epithelium.*

Steffeck traces their origin to the follicle epithelium, and believes that the germinal epithelium is likewise concerned.

Williams outlines three modes of development: 1. From the Graafian follicle. 2. From the germinal epithelium. 3. From the epithelium of the tube.

Kossmann believes these tumors to originate from abnormally situated islands of tubal epithelium (analogous to the accessory tube).

Pozzi and Beaussenat believe that they originate from the germinal epithelium, from the tubules of Pflüger, and from the Graafian follicle.

Burckhard considers the multilocular cysts to originate from the tubules of Pflüger.

Orth says that the carcinomata and cystadenomata glandulare and papillare originate from the germinal epithelium, or from the follicle epithelium, or from the medullary strands.

Zweifel and Hofmeier say that the follicle is the point of origin.

Pfannenstiel believes that the cystadenomata pseudomucinosa develop from the primary follicle.

Wendeler says that they do not originate from the follicles, for, in his opinion, the follicle epithelium does not originate from the germinal or any other epithelium, but from the fetal connective tissue of the Wolffian body. He believes, further, that the epithelial covering of the ovary is to be considered the matrix of all the epithelial ovarian tumors.

Wendeler mentions that Pfannenstiel has shown us that tubular depressions of ciliated cylindrical epithelium may originate *from every point of the ovarian surface,* and that *at every point of the surface* of the ovary ciliated epithelium may be found in pathological conditions.

It is worthy of mention that the pathological conditions in the ovary could be easily explained if we were to change this observation and let it read: the pathological conditions stand in a causal relation to the frequently found ciliated epithelia in pathological conditions of the ovary. This view finds support in the fact that Kossmann believes that cystomata glandulare and papillare originate from displaced islands of "Müller's epithelium." Because of its importance I quote the following by Wendeler:

> "Kossmann considers it strange that out of the apparently non-functionating surface epithelium of the ovary, in which at no time a mucous secretion has been found, there should be formed in these cysts an epithelium so differently formed and characterized by an active secretion of mucus. He believes that these objections may be overcome if we consider the glandular and papillary cystomata to originate from islands of 'Müller's epithelium,' in these cases from epithelium of the 'cervical type.' He takes it for granted that (analogous to the conditions which are normal in the lower vertebrates) in human beings, frequently in addition to the abdominal end of the tube, other accessory formations result which are to be considered as rudimentary ducts of Müller, presenting more or less deep depressions and also flat insular areas of ciliated epithelium. Just as the epithelium of the normal duct of Müller is differentiated in its various sections, so that at its proximal end it is a ciliated epithelium in the tube and uterus, and at its distal end it is the mucus-secreting epithelium of the cervix, in the same way does Kossmann consider it much more probable that in a rudimentary duct of Müller, even if it is only an inversion in the ovary, a part of the epithelium takes on the cervical character. He considers this more probable than that from the non-functionating rest of the germinal epithelium (the surface epithelium of the ovary) cyst formations should result resembling histologically the retention cysts of the cervix. Kossmann calls to mind

> as proof of this hypothesis the recent view of Ribbert *that the isolation of cell complexes from their normal connection, and the removal thereby of normal control of growth, is to be considered the cause of neoplasms.* There is no question that Kossmann's proof of a relatively high percentage of paratubal formations speaks decidedly for the possibility of analogous displacement of 'Müller's epithelium' upon the surface of the ovary, and furnishes this clever hypothesis with a powerful support. In fact, we are relieved of all difficulties by this theory of Kossmann, according to which the serous (papillary) as well as the glandular cystadenomata and also the simple non-cystic adenomata are supposed to develop from displaced groups of 'Müller's epithelium.' I am inclined to accept this theory, and will only add that we must naturally, therefore, refer the origin of malignant neoplasms to the same source."

What Kossmann says against the origin of these tumors from the germinal epithelium may be likewise quoted against the follicle epithelium and the medullary strands, so that it is scarcely necessary to criticise the different views concerning the origin of cystadenomata.

Nagel says:

> "Von Franqué found an unusually large number of primary follicles in an ovary of a 20-year-old girl; the other ovary was degenerated into a cystoma. Von Franqué agrees with Hellin that women with such ovaries are inclined to multiple pregnancy. In the same ovary Von Franqué found *extensions of the parovarian tubules in all parts of the ovary, also in the zona parenchymatosa up to the surface of the ovary; here and there cysts had developed from these tubules.* Since the other ovary was changed to a cystoma, this condition—contrary to the view of Von Franqué—is of value in supporting the view of Cornil and Von Recklinghausen *that these cystomata develop from remnants of the primary kidney.* Von Franqué describes further the ovaries of a fetus 48 centimetres long, with increased physiological activity, so far as the formation and disappearance of Graafian follicles is concerned: the stroma of the ovary showed no changes; a strong hyperemia of the pelvic organs was noted. There is no need—contrary to the view of Von Franqué—to consider this condition pathological and to grant it the name of 'small cystic degeneration.'"

From our embryological illustration and from the other observations and quotations we observe the following facts:

1. The pronephros furnishes, through its tubules, direct communication between ectoderm and celom.
2. The Wolffian duct, if it does not develop from the ectoderm,

lies at least *closely united to the ectoderm.* Its tubules pass through the mesoderm up to the celom.

3. The further the Wolffian duct goes in its course to the cloaca *the more is it separated from the ectoderm.*

4. The ovary is developed from cells of the germinal epithelium. Cells from the Wolffian body are concerned in its development. The tubules of the primary kidney may themselves be taken up in forming the ovary.

5. Although the tubules of the parovarium usually end blindly at the hilus, they may, according to Nagel, extend into the zona vasculosa ovarii, and

6. The parovarian tubules may be found, as Von Franqué has shown, in all parts of the ovary, even under the surface.

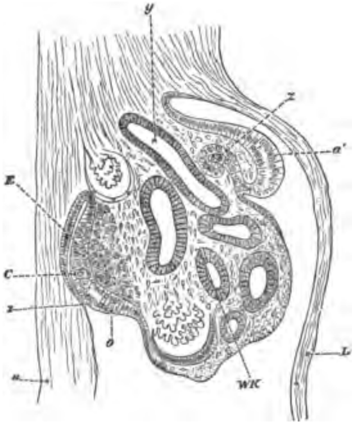

FIG. 44.—Transverse section through the Wolffian body (urniere), duct of Müller, and the germinal gland of a chicken at the fourth day (Waldeyer). *WK*, urniere; *y*, Wolffian duct; *m*, mesentery; *L*, posterior body plate; *a*, germinal epithelium from which the anterior end of the duct of Müller (*Z*) has originated; *n*, thickened part of the germinal epithelium in which the primary germinal cells *C* and *o* lie; *E*, modified mesenchym from which the stroma of the germinal gland is formed.

7. According to Cornil and Von Recklinghausen, the cystomata develop from rests of the primary kidney.

8. The ligamentum latum represents the epithelial covering, celom epithelium, and the connective-tissue basis of the Wolffian body. Fig. 44 shows the close connection of these structures during embryonal life.

9. The various parovarian formations of the ligamentum latum show ciliated epithelium, and are *rests of multiple segmental unions between the primary kidney and the celom.*

10. These structures originate in the mesoderm (but not from the mesoderm), near the celom; certain cells of the ger-

minal epithelium form the ovary and the ducts of Müller. The ducts of Müller contain ciliated epithelium and furnish the epithelium of the cervix, high cylindrical cells with nucleus at the base.

11. Kossmann considers that the cystadenomata develop from islands of "Müller's epithelium," because the cells of a cystoma glandulare have the "cervical type."

12. The isolation of cell complexes from their normal relation, and the thereby removed control over normal growth, is to be considered the cause of neoplasms.

13. The ovarian epithelium is frequently ciliated in cases in which the one or other ovary contains cystomata.

14. Kossmann's theory does not explain the frequent occurrence of the intraligamentous and intraovarian cystadenomata.

15. Olshausen believes that the proliferating cystomata originate from the parovarium, because they contain ciliated epithelium and are frequently intraligamentous.

16. As we shall later see, the same cystadenomatous growths are found *in the tissue of dermoid cysts of the ovary and testicle.*

17. Cystadenomata are frequently combined with dermoid cysts in the same or other ovary.

18. In Marchand's case of a retroperitoneal dermoid cyst, cysts were present of the same character as cystadenomata of the ovary.

19. The mixed tumors of the kidney and the dermoid cysts of this region develop from cells, including ectoderm cells, which have been displaced from their normal position. The primary kidney is responsible for this change.

20. The mixed tumors and dermoid cysts of the cervix, vagina, and bladder are caused by a displacement of cell complexes by the growing Wolffian duct.

We may therefore draw the following conclusion:

The pronephros, the primary kidney, and the Wolffian duct, through their position in the mesoderm, their connection between ectoderm and celom, their relation to the normal development of the ovary, their future position at the hilus of the ovary, the position of the tubules of the primary kidney near the hilus, their growth through the hilus into the zona vasculosa, their growth through the ovary even up to the surface, through the fact that their rests furnish the ciliated growths of the ligamentum latum, are capable of carrying with them ectoderm and mesoderm cells up to or into the ovary, and of forming ectodermal and mesodermal products and structures lined with ciliated epithelium.

In this way the mesodermal tumors, the mixed tumors and dermoids of the ovary and testicle originate. I believe that the cystadenomata glandulare and papillare are developed from the Wolffian body or from ectoderm cells displaced by it, since these structures to a greater or lesser extent occur in every dermoid cyst of the ovary and testicle. The cystadenomata of these organs are not infrequently bilateral, and in the ovary are frequently combined with dermoid cysts. Ziegler says: "The cystadenomata may be united with dermoid formations; cystadenomata of the testicle frequently include in the stroma cartilage centres, or show other tissue forms, so that we must call these growths 'teratomata.'"

I believe that this fact speaks for a displacement of cells for which the Wolffian body is responsible. In describing a case which had been called "myxosarcoma" of the testicle, Wilms says: "The entire tumor is made up of young embryonal connective tissue, cartilage, smooth and striated muscle, some squamous epithelium, cysts and tubules lined with cylindrical epithelium, which showed glandular structures in their neighborhood." "The name 'myxosarcoma plexiforme' is therefore incorrect, even though in certain areas this tumor resembles that form. A simple consideration of the tissues of which the tumor is composed shows that we have the products of all three blastodermic layers. It therefore seems justified to state that the tumor has developed from a germinal formation containing the three blastodermic membranes. If we consider the tumor from this standpoint, there is nothing strange in the presence of squamous epithelium or cartilage or striated muscle, and we are forced to consider it a teratoma."

Wilms believes that all three blastodermic layers are represented, because he makes the error of considering the cystadenomatous structures to be entoderm. The fact that around these structures muscle fibres were grouped leads him to call them intestinal structures. I mention the following cases to show that the same error has been made by others.

In his case Marchand described the cyst formations in the following terms: "The largest, on opening, showed thick, cloudy, grayish contents, like the contents of an ovarian cyst. The entire inner surface is lined with well-preserved simple ciliated epithelium, consisting of rather short cubical cells with long nucleus." Concerning another cyst he says that "the mucous membrane has the character of *the mucous membrane of the large intestine;* the inner surface was lined with high, delicate cylindrical epithelium; in stained sections there was found an external longitudinal and an internal thicker transverse layer of smooth muscle fibres. The mucous membrane showed numerous tubular glandular depressions, which were lined with *distinct beaker cells like those of the large intestine.*"

From the case of Weigert which has been quoted I mention again the following sentences:

> "One space is remarkable because of its peculiar form; it has the form of intestine or a sausage. In transverse section it has a lumen which is star-shaped through the projecting longitudinal folds. The epithelial elements of the cystic spaces are of three forms: 1. Most rarely they have a lining of stratified squamous epithelium. A second form is lined with simple cylindrical epithelium consisting of high cells with peripheral nucleus. On the surface there is found in the larger spaces a cloudy mucus which in the deeper divisions shows a form corresponding to cell boundaries. Such masses of cells rest upon a connective-tissue basis, partly in long tubules with long lumen or in cystic spaces. They clothe further the above-mentioned tubular bodies. They do not lie here as a simple layer on the projecting folds, but form very regular closely lying tubular glands *of the form of the glands of Lieberkühn.* They rest upon a firm layer, next to which is a loose layer which is sharply lined off from the external membrane. The latter consists of well-developed smooth muscle fibres which are arranged in two layers, an inner circular and an incomplete external longitudinal layer. In the connective-tissue stroma lie here and there large groups of lymphoid cells. The cysts of the third form are lined with a stratified ciliated epithelium."

Neumann described a dermoid of the ovary in which he found

> "A small space the size of a pea; its wall is thick, its lumen filled with tenacious mucus, the inner surface lined with a soft membrane. Near it is another like structure, which differs in its external form, in that it represents a long, intestine-like tube. Sections through this space give a picture *corresponding to the normal intestinal wall:* internally is a mucous membrane in which numerous closely grouped tubular glands with well-developed cylindrical epithelium are found; they are bounded by a muscularis mucosæ under which is a loose connective-tissue submucosa, and externally is a thick layer of smooth muscle fibres arranged in layers crossing at right angles. In this part of the tumor where the intestine-like cysts and the smaller dermoids are, were found remnants of ovarian tissue with follicles and a corpus luteum."

Concerning cystadenoma pseudomucinosum Gebhard says: "These peculiarities are found most distinctly in the so-called 'grape-like cystomata of Olshausen,' in which the individual cysts hang from small pedicles, so that the whole tumor has the appearance of a large hydatid mole." Olshausen explains the origin of these peculiar formations through the theory of accessory ovaries. Pfannenstiel believes that they develop from remnants of the Wolffian body—an explanation which is undoubtedly correct. As may be seen from Figs. 55 and 56, the tubules in the cystadenomata of the ovary have an absolute resemblance to those mentioned in the cases of Marchand, Weigert. Neumann, and Wilms. Beaker cells make the resemblance still closer, and in these, as in the other three cases, the same form of tenacious mucus is found contained. Since, according to our theory, these cysts of the ovary develop from certain cells of the ectoderm, or, better still, from the Wolffian body (ectodermal origin), and since the kidney dermoids (retroperitoneal) also are caused by the urniere, and since the cystadenomata of the latter originate in the same way, we may accept a common origin for all these intestine-like tubules—viz., from ectoderm. The same holds true for the dermoid cysts behind the eye, and also for dermoids of the hypophysis duct, in which the same intestine-like tubes were present. In a preliminary article[1] I said that the cystadenomata of the ovary originate from displaced entoderm cells, because their glands were like those of the intestine (high cylindrical epithelium with nucleus at the base, beaker cells, mucus, etc.). I supported this view on the hypothesis of Waldeyer and Hertwig that the celom epithelium was of entodermal origin. The following discussion will show, however, that those cells of the celom epithelium which are concerned in the formation of a cystadenoma are really ectoderm cells, and, therefore, all these tubes and glands, as well as the glandular structures lined with cylindrical epithelium and ciliated epithelium, are to be considered in all the quoted cases as ectoderm products.

Kollmann says:

> "The peritoneum consists of changed mesoderm; it furnishes the sexual cells which fulfil the duty of propagating the species. From the internal blastodermic layer develop the epithelia and the gland layers; from the mesoderm are developed genuine epithelia (?), as also the ducts of Müller and of Wolff and the primary kidney, and the epididymis as well as the epithelia of the kidney, in so far as this organ is derived

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[1] Berliner klin. Wochenschr., 1900, No. 9.

from the Wolffian duct. The mesoderm furnishes, in fact, *two entirely different tissue forms* (?)—*namely, muscle and connective-tissue elements on the one hand, and on the other hand epithelia* which, because of their origin, may be best called 'mesothelia.' Mesothelium is found, in addition to the mentioned organs, on the inner surface of the celom, and on the inner surface of the vessels in the form of endothelia, and also in the ovary as follicle cells. In the region of the excretory apparatus mesoderm retains for a long time the power to form epithelium *which resembles that of the intestinal canal.*"

This fact explains the reason wherefore structures which originate from the Wolffian duct and the Wolffian body cause glands and tubes which have by so many authors been considered to be intestine-like. Since these organs are of ectodermal origin, we may understand why these same structures may occur in tumors in other parts of the body where the ducts of Wolff and the Wolffian body are not present. Further, it is strange that mesoderm which forms the so-called "connective-tissue elements," among which no epithelial tumors occur, should also form epithelia. Therefore, Kollmann says: "Because of this fact the idea has been put forward that the blastodermic layers have no value as regards histogenesis, and embryology finds itself to-day accepting this view more and more. We consider two epithelial layers, ectoderm and entoderm, and believe that from them all other tissues develop. The results of this theory are extensive. Within the limit of embryology, therefore, the theories as to normal tissues cannot remain confined, but *advance into the realm of pathological histology* and cause there a no less extensive change and uncertainty in the judgment of many tumor forms."

This pessimistic view may be overcome if we consider that not alone the Wolffian duct and the Wolffian body, but also the ovary and its germinal epithelium, are of ectodermal origin. Hertwig says: "From the external layer develop the epidermis, the epidermoid organs, such as hair and nails, the epithelial cells of the skin glands, the entire central nervous system and the spinal ganglia, the peripheral nervous system, the epithelium of the eye, ear, nose, etc., the lens of the eye."

The primary inner layer is divided into:

1. The secondary internal layer, or intestinal gland layer.
2. The middle blastodermic layers.
3. The chorda.
4. The mesenchym cells.

Spee has plainly shown, however, that the chorda does not develop from entoderm, but from ectoderm.

Many believe with Spee, and against Hertwig and Waldeyer, that the peritoneum is not of entodermal origin, and that it is no epithelium at all, but only connective tissue.

As regards the ectodermal origin of the Wolffian duct, the Wolffian body, and the ovary (partly) and its germinal epithelium, the accompanying drawings, taken from specimens of Prof. Spee, will show that this is not to be questioned.

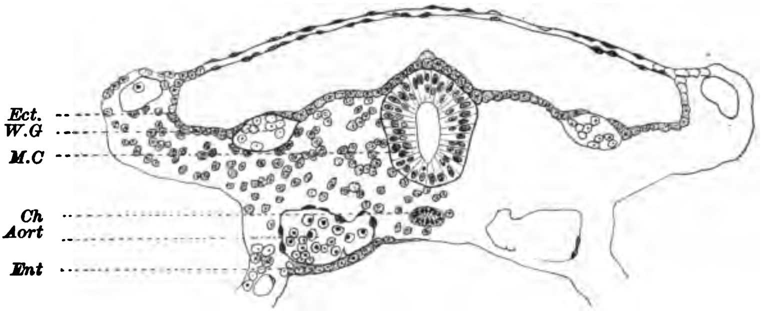

FIG. 45.—Transverse section through rabbit embryo.

In Fig. 45 are seen ectoderm (*Ect.*), the Wolffian duct (*W.G.*), the medullary plate (*M.C.*), chorda (*Ch.*), aorta, entoderm (*Ent.*). It is seen that the Wolffian duct has become outlined from the ectoderm, with the exception of two cells which at the same time form part of the wall of the Wolffian duct and establish the continuity of the ectoderm.

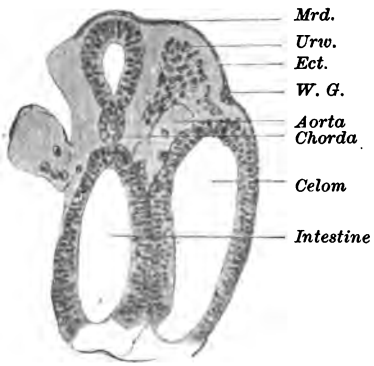

FIG. 46.—Transverse section through guinea-pig embryo.

Fig. 46 shows the medullary plate (*Mrd.*), primary vertebra (*Urw.*), the Wolffian duct (*W.G.*), aorta, chorda, celom, and intestine. We see the connection between ectoderm (*Ect.*) and the Wolffian duct.

Fig. 47 shows the area (*W.G.*) taken from three different sections. It may be seen how in *a* the Wolffian duct is not entirely separated and independent of the ectoderm, while in *b* and *c* this change has almost taken place.

In Fig. 48 we see the medullary plate, myotom, chorda, aorta, the Wolffian body (*Urn.*), the duct of Müller (*M. G.*), the celom, mesentery, intestine (it is not possible to say whether *M. G.'*, Figs. 48, 49, etc., is the duct of Müller or a part of the Wolffian body). At that point where the duct of Müller and the urniere lie is found later the germinal epithelium and the ovary.

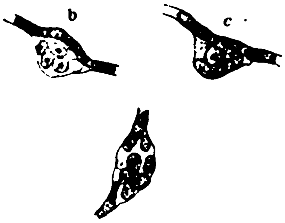

FIG. 47.—Wolffian duct.

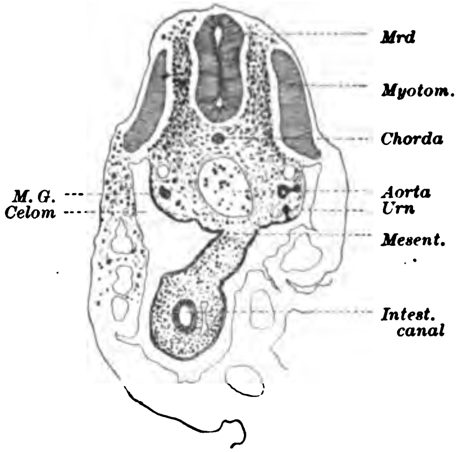

FIG. 48.—Transverse section through guinea-pig embryo.

The Wolffian duct has therefore separated from the ectoderm, and has made its way deeper down to the celom, and has taken with it those elements from which not alone the primary kidney and its tubules develop, but also ectodermal elements from which the germinal epithelium originates.

I show four drawings from various sections which make these facts clear. In Fig. 49 is seen aorta, a vessel, the duct of Müller, the urniere with a tubule (*U. C.*), which in Fig. 50 is still clearer, although here the connection between the tubule and the Wolffian duct is interrupted through the plane of the section. *K.E.* represents the germinal epithelium.

In Fig. 51 we see only parts of the wall of the tubule (*Urn.*), the Wolffian duct, and the duct of Müller. In Fig. 52 we see the urniere and the Wolffian duct in the form seen in Fig. 26.

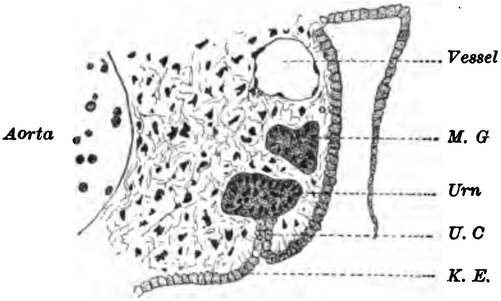

FIG. 49.—*M.G.'*, Fig. 48, strongly magnified.

It follows, therefore, that the tubules of the primary kidney are developed from the Wolffian duct and not from the celom. Spee says that in this way ectoderm cells are brought to this part of the celom, and that from these the germinal epithelium and the ovary develop, so that ovary, primary kidney tubules, Wolffian duct, and duct of Müller are all ectodermal products. Since these, at least partly, are lined with ciliated epithelium, and since from them structures develop which resemble the epithelial tissues of the intestine, we can understand that from ectoderm tumors may develop of the kind observed in cystadenomata of the ovary, in cystadenomata of the kidney region, in dermoid cysts of the eye, and in der-

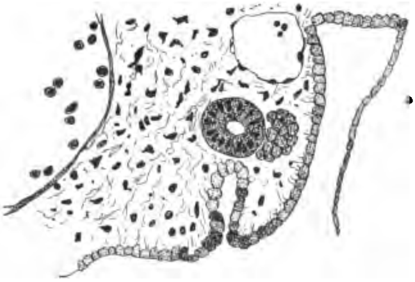

FIG. 50.

moids of the hypophysis duct. Ciliated epithelium, glands with beaker cells, develop normally in these regions from ectoderm, such as salivary glands, the ciliated epithelium of the nose, the ciliated epithelium in the hypophysis duct, etc. Von Recklinghausen says the following concerning the epithelium of the Wolffian body (" The Adenomyomata and Cystadenomata of the Uterus and the Tubal Wall; their Origin from Rests of the Wolffian Body "):

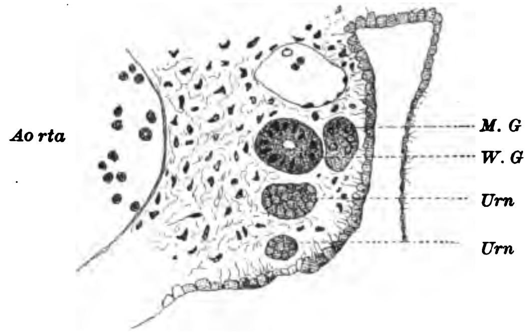

FIG. 51.

" 1. Already in the early embryonal period the epithelium of certain areas of the tubules of the Wolffian body, and, in fact, those cells which at their height of development are cylindrical, are furnished with cilia.

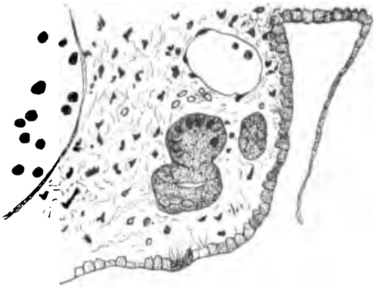

FIG. 52.

" 2. In newly-born mammals, but also in adult women, cilia may be found in the rests of the Wolffian body, surely in the epoöphoron.

" 3. The special, and perhaps normally the only, area of the primary kidney tubules which possesses cilia is the middle section of the tubules.

" 4. The areas of transition of the tubules into the main canal—namely, the outlets of the collecting tubules, as well as the main tube, the Wolffian duct—are free of cilia, at least in the higher vertebrates, and especially in man (Dohrn, Rieder). The statement of Preuschen that the latter possesses some cilia in the fox is the only diverging view.

"5. That end of a primary kidney tubule which begins at the Malpighian body can be followed in earliest embryonal periods beyond the capsule of Bowman up to its funnel-shaped beginning in the pleuroperitoneal epithelium. These peritoneal or primary kidney funnels, the nephrostoms, the well-known ciliated funnels of fishes, amphibia, and reptiles, are to be found in the embryos of the higher vertebrates and in man, but cilia in their epithelium have not been positively found.

"These observations teach us that cilia are an important element of the epithelium of certain sections of the primary kidney tubules, and we may agree that the large ciliated cysts which so often occur in the region of this organ—*i.e.*, parovarian cystomata—are derivatives of the Wolffian tubules. The scattered occurrence of ciliated cells, which form islands among non-ciliated cells, is known to me in many ovarian cystomata, perhaps such which, like the parovarian cysts, stand in genetic relation to the Wolffian body."

We therefore see that cysts lined with ciliated epithelium may develop from the Wolffian body (ectoderm), and, as we shall later see in drawings taken from our specimens, on the surface of a dermoid prominence cylindrical epithelium often goes directly over into squamous epithelium, and then again into ciliated epithelium, and then into squamous epithelium, etc. In these specimens we will also see glandular structures and cysts lined with squamous epithelium, some with cylindrical epithelium, some with high cylindrical epithelium with many beaker cells, and others lined partly or entirely with ciliated epithelium, so that the fact that all these structures develop from the Wolffian body or from certain displaced ectoderm cells stands in harmony with the facts which Von Recklinghausen mentions.

Von Recklinghausen says further:

"The discussion concerning their origin from the epoöphoron tubules concerns to-day mainly the large ligament cysts, those whose contents may reach one or more quarts. When their size is larger than that of a man's head, can they have developed from such a small organ whose secreting ability is unknown, and even from one ovarian tubule? Fischel believes this to be the case. Kossmann denies it, because such an opinion concerning the cysts does not explain the occurrence of the low, irregular prominences occurring in the wall as numerous elevated folds, which, however, may be explained if these elevations are traced back to the mucous membrane folds of an accessory tube. In addition the parovarium has been found by Klob on the wall of the ligament cysts, by Fischel in a retrogressive condition, and by Kossmann entirely unchanged.

"I must prove the error of this attempted change of opinion; to this I am led by the results of the examination of a large cyst situated in the lateral part of the ligamentum latum and extirpated without the ovary. This I received from the surgical clinic of Madelung in a fresh and unopened state. Acquainted with conditions obtained in examining adenomyomata and adenocystomata, I found here the desired opportunity to test these facts and to prove the points speaking for the development of the cyst from remains of the Wolffian body. We found partial ciliation in the pigmented wall at the situation of the gland ducts, and likewise pigment bodies in the cyst contents. We were able to find the cylindrical tubular glands lined with cylindrical epithelium, not alone *externally, but also within the inner layers of the cyst wall,* and *followed one such tube up to its entrance into the cyst space.* In this way the typical relation of the cysts which are formed from the Wolffian tubules was disclosed.

"Recently Pilliet described a cyst removed from the ligamentum latum in whose thick wall the ovary was flattened out. It went at one side over into a canal the size of a finger. Since the wall of the latter showed numerous crypts and short branching pear-shaped glands with simple prismatic beaker cells, Pilliet believed it to be a derivative of the organ of Rosenmüller and called the connected canal the dilated duct of Gärtner. Yet this opinion seems to me to be capable of several objections.

"Killian found in one case in the connective-tissue stroma of the cyst wall structures resembling *the intestinal glands of Lieberkühn,* but believes that they develop secondarily from the depressions of the plaited wall, in that their cylindrical epithelium sinks into the connective tissue, while I, on account of their character, must consider them as rests of the frequently-mentioned branches and diverticular lateral extensions of the parovarian tubules. Whether I, with Orth, should think of the paroöphoron instead of epoöphoron tubules, which I distinctly found in the subserous covering of the cysts, will be left undecided.

"According to my theory, whereby the discussed adenomata are considered as derivatives of the Wolffian body, I was compelled to examine the mesosalpinx of my material in its medial portion for the conditions mentioned by Waldeyer and Kobelt. This I did in the specimens taken from the cadaver where the medial part of the mesosalpinx had not been cut off or injured by operation or destroyed through chronic inflammation and adhesion, and also in specimens where the uterus was removed by operation. A positive result was not granted me, nor could I find absolute evidences of Waldeyer's tubules lined with epithelium, or Kobelt's radiations in that part of the ligamentum latum near the thick tubal angle.

Neither did I succeed in finding rests of the Wolffian body, paroöphoron, in the uterus or tube wall of newly-born children, and I recognized that in this point there is unfortunately a weakness in my arguments.

"Even though, in a revision of the literature of adenocystomata of the ovary, I found no descriptions and no statements which make a favorable comparison with the conditions found in our adenomyomata of the uterus, as is the case in the descriptions of testicle cystomata, yet the theory rests on a good foundation that *certain forms of ovarian cysts originate from rests of the Wolffian body enclosed in the hilus of the ovary.* This opinion has been frequently mentioned concerning the ciliated cysts found in the ovary, and an examination of these, in view of the now recognized conditions to be found in adenocystomata of the uterus and tube wall, will soon call forth a decided judgment as to its truth."

We believe the dermoid cysts to originate from cells, ectodermal and mesodermal, displaced by the Wolffian body. We believe further that entodermal elements are not found in these cysts, and that all these intestine-like and ciliated structures are of ectodermal origin and originate in all probability from the Wolffian body. Cystadenomata of the ovary are found to be frequently combined with dermoid cysts. They may be found side by side in the same ovary, or may form a double tumor, or may be united by adhesion and perforation of their walls into one tumor. *In the dermoid prominence* of almost every dermoid cyst, whether a cystadenoma is present or not, we always find those smaller or larger glands or cysts which in every way have absolutely the same structure, cell for cell, as is found in cystadenomata of the ovary. In almost all cases ciliated epithelium is present, either on the surface of the prominence or as the lining of the glandular structures or cysts. Since the dermoid cysts may without doubt be referred to the Wolffian body, it may be granted that when no special ectoderm or mesoderm cells are displaced (which form squamous epithelium, sebaceous glands, hair, bone, cartilage, muscle, glia tissue, etc.) the Wolffian body itself forms a simple cystadenoma of the ovary.

I have found, in sections through that part of an ovarian dermoid (Fig. 53) corresponding to the hilus, the same structures which Von Recklinghausen described and illustrated as glandular elements of his adenomyomata of the uterus. Near them was a large area containing many pigment cells (Fig. 54), near which was found squamous epithelium. Near it was a depression which I have frequently found in the ovarian tissue of ovarian dermoids, and its epithelium resembles the lining of those glandular structures which I have just called Wolffian body. Some of these structures are lined with simple cylindrical epithelium, others by cylindrical epithelium partly ciliated; in some of these glandular structures are found pigment cells with distinct dark nucleus. The largest gland is lined with stratified epithelium containing at some points pigment. Around them is a layer of small round-celled tissue, and the entire group is embedded in connective tissue. The ovarian tissue in which these structures lie contains numerous large and small vessels, so that there is no doubt that we are here dealing with the hilus. The entire area resembles the description and the drawings of Von Recklinghausen.

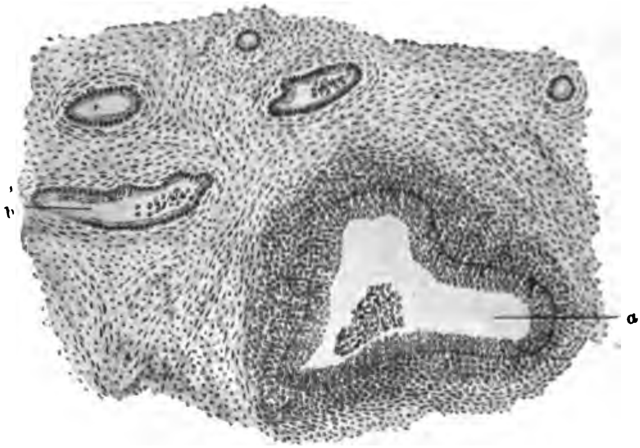

FIG. 53.—This figure shows the above-mentioned tubules of the Wolffian body. Canal *a* contains in part ciliated epithelium. Section through hilus of dermoid ovary.

To explain this pigmentation as an *ectodermal product* I quote the following by Von Recklinghausen:

> "The characteristic element of the glandular structures in our tumors (uterine adenomyomata), their alpha and omega, is the tubular gland lined with a single layer of cylindrical epithelium (ciliated epithelium), whether the gland forms a regular cylinder or whether it changes its width or shows partial dilatation or projections; whether it is long or short, or whether it takes a straight or a twisting course. The typical accompanying and embedding tissue about the gland tubules is the cytogenic tissue (Kölliker), that loose connective tissue rich in small round and short spindle cells, and so poor in a fibrillary framework; that tissue called by His 'lymphadenoid' basal substance, and which we find in mucous membranes that are rich in blood vessels, such as in the uterine mucous membrane.

"The larger the number of the gland tubules in any area, the stronger is the embedding cytogenic connective tissue developed."

In the cysts Von Recklinghausen frequently found "very large, almost round bodies, noticeable because of their yellow color, and also nucleated cells and pigment bodies. The brown contents which are often found in the opened cysts are the result of blood extravasations, at least of a diapedesis with following metamorphosis of the red blood cells. For such a hemorrhage speaks also the fact that in the neighborhood of these tubules and cysts filled with brown substance brown pigment cells are found, which may unite with the projections of the interstitial connective-tissue bundles."

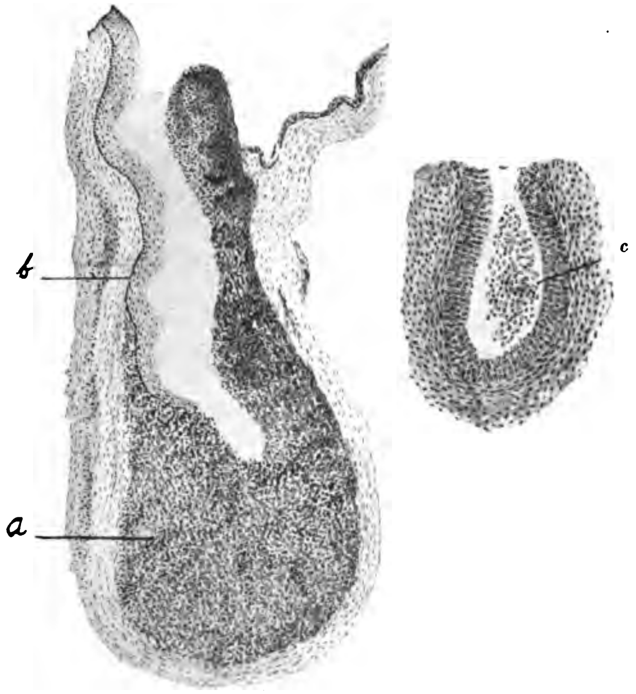

FIG 54.—*a*, region with pigmented epithelial cells; *b*, squamous epithelium; *c*, a depression lined with the same epithelium as in *a*, Fig. 53. Section through hilus of dermoid ovary.

That this pigmentation is a peculiarity of the paroöphoron, or "yellow body," may be seen from the following statement:

"Waldeyer mentioned this strong pigmentation in the paradidymis, and found therein a reason for assigning the 'yellow body' in the mesorchium and mesovarium—which, because of the intensity of its color, was taken for the suprarenal body—to the Wolffian body. Czerny discovered the cause and the situation of this coloring in all these yellow bodies by examination of the fresh specimens microscopically."

The brown, brown-black, and seldom brownish-red color of the contents, as also the pigmented areas of the edematous tissue, are considered by Von Recklinghausen to be a typical criterion of these adenocystomata which originate from the Wolffian body. He found in addition other cells. "They are large, plump, and oval cells, but often polyhedral, like those described by Czerny, and like the pigment bodies in the lumen of the ducts. They lie, as a rule, in long rows so close together that each touches the neighboring cell and *compresses it.*" In another like condition Von Recklinghausen describes a group consisting of "fairly large polyhedral cells, partly diffusely stained yellow, which lie *distinctly in mosaic* and also in epithelial order, and only separated from each other by a very small amount of intercellular substance." Since no evidence of gland tubules in these epithelial cell groups was found, he can mention only one gland in which the epithelial gland cells form solid groups, namely, the suprarenal body. In observing the epithelial structure of this yellow nodule in a cyst wall, and in considering those strongly stained areas in the connective tissue of adenomyomata, he was reminded of Marchand's description of accessory or displaced suprarenal bodies, namely, 0.1 millimetre nodules which he found in the closest relation to the vessels of the spermatic plexus in the lateral wall of the ligamentum latum of a first-year baby girl, and mostly between the layers of the ligament in the region of the ovary and the parovarium.

"With the yellow 'granular areas' of the broad ligaments (paroöphoron) may be compared the yellow areas in my tumors," says Von Recklinghausen further, "even though I must grant that the proof of their origin from the Wolffian body (by which Czerny means the glomeruli) has not been found, not even in the late embryonal period."

One more mention as regards the pigment. Von Recklinghausen says:

"Should this, if it really originates from the disappearing glomeruli, not be considered later also *as an evidence of the urniere portion of the Wolffian body*, and should the other, the sexual portion, not be characterized by the absence of pigment? Most authors follow Waldeyer in the statement that the paroöphoron is the rest of the secreting portion of the

Wolffian body, and is found in the medial part of the ligamentum latum, even up to the uterus. When we, then, in tumors of the wall of the female genital canal find *noticeable pigmentation, and if such pigmentation is considered a special characteristic of the paroöphoron,* the question must be considered if through the presence of pigment *we are not furnished with an evidence which characterizes our tumors also,* and permits us to consider those which are furnished with pigment as originating from the urniere portion of the Wolffian body. Finally, I will mention that in the organ of Rosenmüller, in the parovarium of Kobelt, in the parovarian

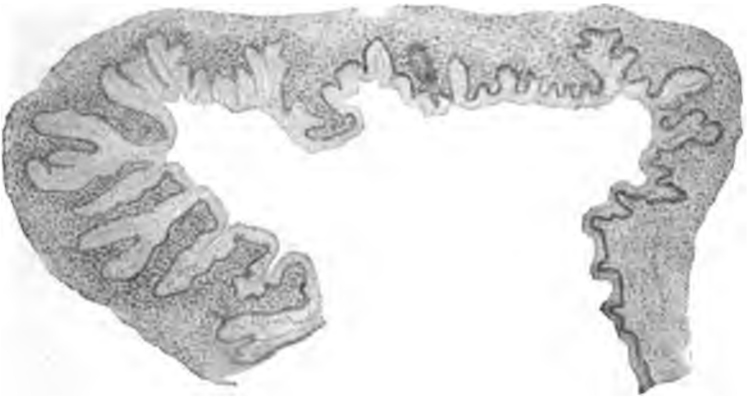

FIG. 55.—From the wall of a cystadenoma of the ovary with "intestine-like" glands.

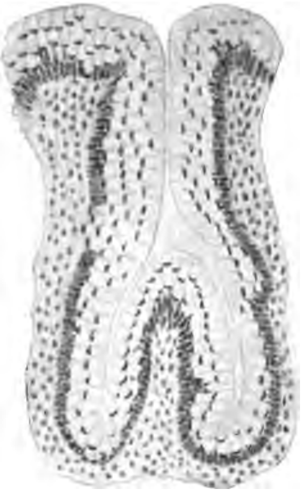

FIG. 56.—A gland from Fig. 55 strongly magnified.

tubules, in their walls and in the genuine parovarian cysts, the same pigmentation occurs as we have found so regularly in our uterine tumors (adenomyomata). Either all the remaining remnants of the entire Wolffian body have a tendency to bleeding and to pigmentation, or else the remnants of the 'urniere' portion are specially disposed to these changes and are to be found, as well as in the uterus, also along the tube or in the broad ligament up to the ovary. The paroöphoron does not always confine itself to the medial portion of the internal genitalia, and, on the other hand, the epoöphoron may extend up to this area. At least as regards pathological conditions, we are not compelled to follow the lines of limitation marked off by Waldeyer for the paroöphoron and epoöphoron."

The preceding and following illustrations are given to compare the glandular structures in cystadenomata of the ovary with the same structures in the "dermoid prominence" of ovarian dermoid cysts.

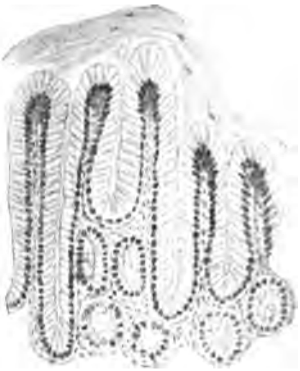

Fig. 57.

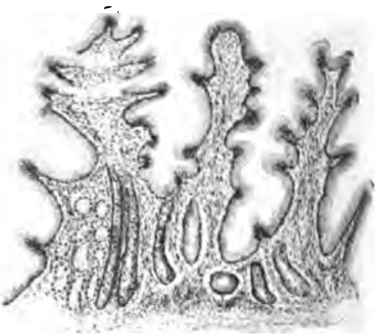

Fig. 58.

Fig. 57.—"Intestine-like" structure from the prominence of a dermoid cyst, on the surface of the prominence.

Fig. 58.—"Intestine-like" structure from the prominence of another dermoid cyst (at the *base* of the prominence).

According to Ziegler, Pilliet and Costes explain the teratoid tumors of the testicle through a further development of ovarian tissue which is retained at the hilus of the testicle, or else *from rests of the Wolffian body* which are not included in the testicle with physiological function.

Von Recklinghausen says:

"It is not alone those cysts of the testicle which are lined with ciliated epithelium which I with Ziegler refer to such rests of the Wolffian tubules; I hope also, through the previous examination and acquired knowledge, to bring clearness into the still indistinct understanding of the origin of adenomata and cystadenomata of the testicle. The statement of Malassez that they develop in the connective tissue of the testicle is opposed to the older and again recently adopted view of Langhans that the adenomata develop from the seminal tubules of the testicle, although there is a lack of harmony in the fact that seminal threads are absent and that the structure of the new gland tubules is quite different from the normal seminal tubules. The dilated form of the cysts, the connection of gland ducts, cylindrical epithelium in a simple layer (near it stratified squamous epithelium), the presence of cilia, all well-known characteristics of the adenocysts of the female genital canal, are mentioned by Langhans, and his illustrations could be used by me as typical illustrations of the structural conditions seen in our voluminous uterine adenomyomata—I mean the adenomatous portions of the tumor."

That the Wolffian duct and the Wolffian body are capable, through their position in the mesoderm, of displacing with them not only ectodermal but also mesodermal cells, is not to be doubted, since the duct itself has carried ectodermal cells up to the epithelium of the celom.

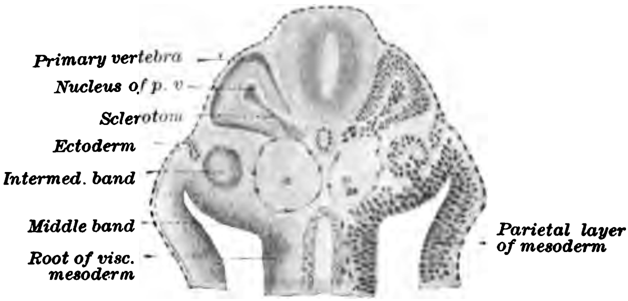

FIG. 59.—Human embryo, end of third week. Transverse section at the level of the arm formation. (Kollmann.)

Where Kollmann speaks of the development of the Wolffian duct and its close connection with the ectoderm, mentioning the statement of some authors that the same perhaps originates from ectoderm or receives some ectoderm cells for its structure, he adds: "Proof of this contact in mammals has still a further interest: it occurs at the boundary of the middle and posterior third. Under abnormal conditions ectoderm cells might be brought into the region of the germinal glands, become attached there, and cause those dermoid cysts which are so frequently found in the testicle and in the ovary."

Prof. Spee says: "The way in which ectoblast cells may arrive at the region of the celom seems to be explained by the fact that *without doubt ectoblast cells are concerned in the* *formation of the Wolffian body and the germinal glands.*" So much for the question of the displacement of ectoderm cells up to the celom or into the ovary.

Concerning the displacement of mesoderm I mention the following: In Fig. 59 is seen the "intermediary band" (*Zwischenstrang*) which represents the Wolffian body.

The dorsal portion of the body mesoderm is already changed or segmented to primary vertebræ; the ventral portion of the mesoderm is not segmented, but only divided, so that the celom results. From the primary vertebræ cells pass out to the medullary canal and to the chorda, envelop them, and form the bony vertebræ. These cells form the "sclerotom." From the primary vertebræ comes the so-called "myotom," or "muscle segment," which later spreads out also into the unsegmented mesoderm.

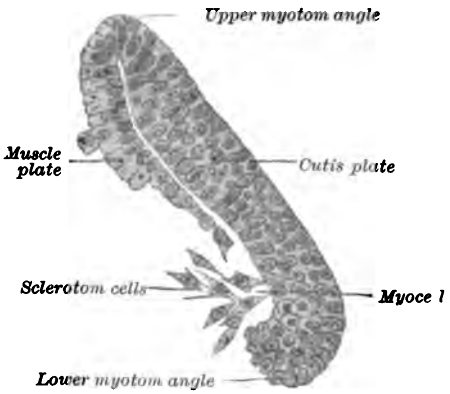

FIG. 60.—Myotom of a buman embryo, end of third week. (Kollmann.)

This myotom (Fig. 60) consists of a medial plate, a muscle plate, and a lateral plate, or cutis plate, and also possesses an upper and a lower angle.

Every "primary vertebra" furnishes:

1. A myotom from which the segmented muscle develops.
2. A sclerotom from which gradually the cartilaginous and finally the bony vertebræ develop.

To show the close connection between primary vertebræ and the medullary canal (ectoderm), I must mention that not only do cells from the primary vertebræ surround the medullary canal and form the vertebræ, but that the primary vertebræ influence a division of the medullary canal, so that each segment of it furnishes a nerve pair.

We may therefore make the following short statement:

The primary segments and the lateral plates are formed from the middle blastodermic layers.

The "primary segments" furnish *striated muscle fibres* and a portion of the mesenchym.

The lateral plates furnish the celom epithelium and the mesenchym tissue.

Certain cells of the germinal epithelium (?) furnish, when removed from their normal position, together with the Wolffian body, cystadenomatous tissue, ciliated epithelium, glands with beaker cells.

Certain cells of the germinal epithelium and the Wolffian body furnish the parovarian remnants of the ligamentum latum.

Mesenchym tissue which spreads everywhere as the interstitial substance between the epithelial elements of the body furnishes *smooth muscle fibres*, mucous tissue, fibrous connective tissue, cartilage, bone, blood vessels (?), blood (?), lymphoid organs, *those tissues which are found in dermoid cysts of the ovary.*

We have seen in Figs. 48 and 59 that the Wolffian duct and the Wolffian body are situated in the mesenchym, and not very close to the "primary segments" which furnish striated muscle fibres, and we therefore may understand why striated muscle is found so very rarely in ovarian dermoids.

Ectoderm furnishes epidermis, hair, nails, the entire central nervous system, and *the spinal ganglia,* and in other situations the epithelium of the eye, the lens, etc.

It is therefore to be seen that smooth and striated muscle fibres originate from quite different centres, so that a metaplasia of one form into the other is not to be considered possible. As a decided support for the possibility of a displacement of cells I quote the following by Switalski:

> "During my examination concerning the conditions in the Wolffian tubules in the newly born and in the fetus of the female sex, I found between the folds of the right ligamentum latum of a newly born child a peculiar hair-like structure.
>
> "The systematic microscopic examination of the specimen showed that parallel to the tube, in the upper part of the ligamentum latum, was a structure which I could follow in twenty-nine sections, each 20μ thick. When reconstructed from this series of sections it is seen to be of a long spindle shape. Transverse sections of this structure show it to be round, very regular and macroscopically visible, and of three-

quarters of a millimetre diameter. About in the middle of its length it comes into direct contact with the Wolffian duct, which is lined with well-preserved cylindrical epithelium. At this point is seen on the posterior wall of this structure a slight depression, and the Wolffian duct is at this point somewhat flattened. The Wolffian duct runs a twisting course and separates itself gradually from this structure. Weak magnification shows in the middle of the structure several layers which resemble the cell layers of the epidermis; toward both ends the number of the layers is less. Strong magnification shows that the ends of this structure are formed of large epithelial cells which lie in several layers. The cells are stained blue, have a large, distinct, oval nucleus, and are filled with numerous small bodies. In some cells are seen small accumulations of a brown pigment. Externally the epithelial cells are surrounded by a small margin of connective tissue.

"This layer-like form is more distinct at the middle, and the arrangement is as follows: Externally we have a covering of connective tissue; then follows a layer of cells with distinct nuclei, and intensely stained points, red through eosin; finally we have a layer of cells whose protoplasm is filled with little bodies stained blue through hematoxylin, and in addition brown pigment bodies. The interior of this structure consists of two layers, the external of which is sharply marked off from the last-mentioned cell layer. It consists of red-stained, homogeneous, flattened and concentrically arranged cells, in which the rests of the nuclei are stained red, but more intensely. The internal layer consists of homogeneous, palered, concentrically arranged cells. In both layers are accumulations of pigment.

"From the description of the cell layers it follows that we are dealing with a continuous series of various stages of hornification. Even though an absolute identity with the cell layers of the skin cannot be demonstrated, it is still certain, especially when we consider the layer of cells with blue keratohyaline bodies, that there is a decided resemblance to the cells of the stratum granulosum and lucidum of the epidermis. The cells forming the central layers are entirely horny, and, aside from their concentric arrangement, resemble the horny layers of the stratum corneum. The brown accumulations of pigment which are found in the entire structures resemble the pigment found in the skin. There is no doubt, therefore, that this structure is of ectodermal origin, and its presence between the layers of the broad ligament can only be explained embryologically.

"All authors who have studied the embryonal development of the Wolffian ducts in mammals are of the opinion that these ducts, which develop from the mesoderm at an early period, are close to the ectoderm and for a long time are connected with it. This fact has given rise to the theory that the external blastodermic layer is concerned in the formation of the Wolffian duct.

"When we consider this fact, that these structures examined above are at least in close contact, and that a mutual depression of the wall has occurred, the explanation of the presence of this ectodermal structure near the wall of the Wolffian duct is very easy. In all probability, as the Wolffian duct made its way from the ectoderm and as it passed through the mesenchym tissue, some cells of the ectoderm which are in close contact were carried along and so brought between the two layers of the broad ligament. This case can be used to throw light upon the origin of the ectodermal structures which are found between the layers of the ligamentum latum.

"That a dermoid cyst may develop here independent of the ovary is a well-known fact. Peters says: 'The Wolffian duct is at an early period of development in close contact with the ectoderm, and it is possible that elements of the latter are used in its formation and slumber in it for a long time, and then form the point of origin for the dermoids.' As we have seen, we know (?) that the ectoderm is not directly concerned in the development of the Wolffian duct, and that in the wall of the Wolffian duct ectoderm elements are normally not present. *As recent examinations prove, and as our case shows, ectoderm elements may, however, be carried into the ligamentum latum as a result of the intimate contact of the ectoderm with the Wolffian duct.*

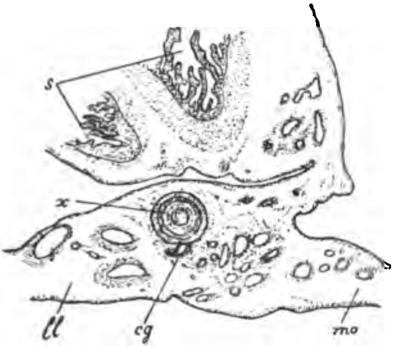

FIG. 61.—Ectodermal structure with the Wolffian duct in a newly born child. *s*, salpinx; *mo*, mesovarium; *ll*, lig. latum; *x*, ectodermal structure; *cg*, Wolffian duct.

"We believe that our case furnishes us with the first evidence of the origin of a dermoid structure, and that its close relationship to the Wolffian duct makes the causal connection between the dermoid structure and the duct beyond doubt."

Fig. 61, by Switalski, shows this ectodermal structure (*x*).

Switalski found in three cases in young fetuses cystic formations in the epoöphoron. In two cases he found two cysts side by side. It seems to him that in the embryonal period there is a tendency to these cystic formations on the part of the epoöphoron tubules. He says that, since Nagel believes the external layer of the tube to develop from the embryonal tissue of the Wolffian body, it may happen that a Wolffian tubule may be taken up into the tube wall. In one case he found in the wall of the tube, and also in the mesovarium, two epithelial structures which in section resembled an adenoma.

From the above description it may be seen that the Wolffian duct and the Wolffian body are in a position to take with them cell complexes from a fairly large area, as is observed in—

1. Mixed tumors of the kidney, wherein are found smooth muscle fibres, striated muscle fibres, cartilage, fat, mucous tissue, etc.

2. Mixed tumors of the cervix, vagina, bladder, vas deferens, etc., wherein among other elements are found striated muscle and cartilage. As may be seen in Fig. 46, the Wolffian duct lies near the "myotom" from which the striated muscle fibres develop. The Wolffian body (Fig. 48) lies, however, deeper and further away from the myotom. The further the Wolffian duct goes in its course to the cloaca, the further does its lower end become separated from the ectoderm; and since the lower end of the duct alone, and not the Wolffian body, is the cause of the mixed tumors and dermoid cysts of the cervix and vagina, these occur in the latter situation much less frequently than in the ovary. For this reason, also, as we have said, the dermoids of the ovary rarely contain striated muscle fibres, because the Wolffian body is not near the myotom. If, as Wilms and Pfannenstiel state, dermoid cysts of the ovary develop from an ovum cell, we should in all cases find striated muscle. This fact alone is sufficient to prove the fallacy of the so-called "parthenogenesis theory."

3. Mixed tumors of the testicle, described under the names adenocystoma, chondroadenoma, chondrosarcoma, adenomyosarcoma, etc., wherein are found cysts with cubical cylindrical epithelium with or without cilia, as well as stratified ciliated epithelium, mucous tissue, cartilage, and sometimes muscle tissue, fat, and, less frequently, bone.

4. Dermoid cysts situated retroperitoneally behind the kidney, mesenterial dermoids, and dermoids of the omentum. The origin of the latter two forms we have already explained, for the mesenchym of the visceral layer in that region where the Wolffian body appears furnishes the mesoderm of the mesentery and the omentum.

5. Dermoid cysts of the cervix and vagina, between the bladder and the uterus, etc.

6. Dermoid cysts of the ovary and testicle.

That the cell complexes which are displaced are not always of the same extent can be seen from the varying structure of the mixed tumors of the kidney and cervix, and Wilms has given an explanation for the varying structure of these tumors, and for the absence of certain tissues, which harmonizes fully with our own theory.

That the mixed tumors of the cervix and vagina should have a less complex structure than the mixed tumors of the kidney is easily understood when we consider that the former are caused by a displacement of cells on the part of the Wolffian duct alone, for this does not come in contact with so many varying tissue cells of the mesoderm as the Wolffian body does, and when we consider further that its lower end, which finally reaches the future cervix and vagina, does not come in contact with the Wolffian body. Therefore we find in these latter mixed tumors very rarely or not at all cystic formations which show an "entodermal character," for these formations come from the tubules of the Wolffian body. The fact that this end, the further it grows downward, becomes the *more separated from ectoderm,* explains likewise the rare occurrence of dermoid cysts in this lower region.

That this entirely complicated area (Fig. 44, ovary, tube, parovarium, paroöphoron, with their close apposition) should give us complicated and more varying tissues and tumor forms than the Wolffian duct alone is to be expected. To show what complicated tumors may result from the Wolffian body, and likewise because it is of value to our theory, I quote the following case of Marchand. It must be observed that momentarily we make no distinction between cystic and solid dermoids of the ovary. The description concerns an almost solid ovarian tumor of very large size, weighing 5,400 grammes:

"The smooth surface of the tumor resembles the character of an ordinary ovarian cystoma; the character of the pedicle, which contains a number of large turgid blood vessels, as well as the presence of a portion of the well-preserved tube, proves distinctly the origin of this tumor from the ovary. The absence of a large cavity is an unusual occurrence. The length of the tumor is 28 centimetres, the width 20 to 22 centimetres, the thickness 16 centimetres.

"The cut surface of the tumor presents an extraordinary picture; we see a number of large lobules which are separated from each other by radial septa. The individual lobules have mostly a cystic structure; they consist of closely compressed small spaces from which a tenacious, yellow, translucent mucus comes, *like the usual contents of the small colloid cysts*, and also a thinner, colorless or white mucus. Everywhere are seen yellow areas which are enclosed partly in cysts, and are partly irregularly scattered between the same. By careful inspection fine hairs are seen in these yellow masses, so that there is no doubt that we are dealing with epidermoid structures. In many spots this cystic structure of the tumor is indistinct; the tumor substance takes on more of a medullary character, is of grayish-red color and soft consistence, with numerous fine vessel branches like soft sarcomatous tissue. Here and there are firmer white connective-tissue bands, very white nodules and pieces of the hardness of cartilage, and directly next to them not infrequently are pointed pieces of bone. As may be seen by closer observation and by touch, there are found, mainly in that part of the tumor corresponding to the hilus, large, irregular bone pieces which are closely connected with the larger septa and with the cystic portions.

"On the cut surface there appear further *several teeth*, which have come from small cysts like tooth follicles, and which show a completed and usually irregular white crown and translucent, semi-soft, rounded roots. Such teeth, on closer examination, are found in large numbers *scattered everywhere in varying sizes*.

"From the macroscopical character it is clear that we are dealing with one of those rare mixed tumors of the ovary which resemble the dermoids, but which, as a rule, have a more complicated structure than these.

"In fact, the microscopical examination, so far as made on the fresh specimen, shows the following forms of tissue:

"(*a*) *Epithelia.*—As a rule they are low, cylindrical epithelia, which in part go over into flat cell forms, and which usually line the small cystic spaces in a single layer. In most of the specimens they appear in such numbers and are so closely grouped that it is difficult to distinguish them from small-celled sarcomatous tissue.

"(*b*) *Ciliated Epithelium.*—With very narrow, high cells and very distinct cilia; they are often found very close to the other forms.

"(*c*) *Squamous Epithelium.*—The above-mentioned yellow masses consist mainly of groups of epidermis cells in various stages of change; well-developed polyhedral cells with distinct nucleus; swollen cells with a shining character; finally, many cells without nucleus, whose boundaries form a fine polyhedral network.

"(*e*) *Well-developed Hair*, with hair follicles and sebaceous glands, is found in large numbers in lamellous pieces which form part of the cyst walls and are either lined with epidermis or with a single layer of cylindrical epithelium. The hairs are very fine, either yellow or pigmented.

"(*e*) *Connective Tissue.*—Aside from the ordinary connective-tissue bands which form the septa and the groundwork of the tumor, there are found in many areas well-developed pieces of cartilage, usually of irregular round or angular forms, with hyaline interstitial substance and round or long cells, which at the periphery are closer together and form a sort of fibrillary perichondrium.

"(*f*) *Myxomatous tissue*, with large, long, spindle and branching cells, and a soft mucous interstitial substance, is present.

"(*g*) *Sarcomatous tissue*, with closely grouped round cells which are indistinctly separated from each other, and which develop from a growth of the cells of the myxomatous tissue.

"(*h*) *Fat Tissue.*—This is found everywhere in the tumor, mostly in the connective-tissue bands, or as isolated nodules which macroscopically are with difficulty to be distinguished from the epidermis nodules.

"(*i*) *Bone*, in larger pieces and in the form of small projections in the connective-tissue bands, where they are like the first projections of bone in the periosteum or in the formation of the cranium.

"(*k*) *Teeth.*—The crown of the teeth consists of well-developed dentine with canals; on its surface is found a thin layer of enamel.

"(*l*) *Smooth muscle fibres occur frequently in bundles in the wall of the cysts.*

"The higher animal tissues are also present; there were found:

"(*m*) *Striated Muscle Fibres*, only scattered, but in the form of well-developed band-like fibres with very clear striation; and finally,

"(*n*) *Nerve Fibres*, in the form of a bundle of slightly twisted fibres which are found to be small medullary nerve fibres. The bundle ran transversely through a membrane which was *filled with hair, hair follicles, and sebaceous glands*, clearly representing a form of cutis. From the larger bundle ran fibres taking an isolated course.

"Subsequent examination showed the following additional elements. In many areas were found small, very black pigment spots, which on microscopical examination proved to be pigment epithelium of the form of the retina pigment. This was found either as a thin layer lining the smaller spaces or else in irregular groups. At any rate, this fact is of great interest, since, so far as I know, this has not been found heretofore in such tumors. In addition there were found in many areas of the tumor well-developed *ganglion cells*, at times very close to the pigment epithelium. The ganglion cells formed groups of various size; the individual cells were of the kind found in the ganglion Gasserii, or in *the spinal or sympathicus ganglia* with capsules. From the ganglia extended fibres, probably nerve fibres. The structure of the cysts proved to be more complicated than at first appeared. Some of them possessed a wall which in its structure resembled entirely *intestinal wall;* there were found broad circular and longitudinal bundles of smooth muscle fibres and distinct glandular depressions of the epithelium, whose cells possess here *the character of beaker cells.* Some of the cysts had a long, tubular form, but of a very small diameter (0.5 millimetre). The outer surface of the wall was frequently covered with ciliated epithelium."

On account of its importance I would call attention to the following statement of Marchand:

"It must be observed that this tumor does not seem to develop, like dermoid cysts, *from one section of the ovary*, but presents a diffuse enlargement of the entire organ. It seems as if the various elements developed from a growth of cells *which were scattered throughout the entire organ.* The opinion has been frequently expressed that these tumors represent *mixed forms of the ordinary glandular cystomata with dermoids*, in that the mucous or colloid cysts are identical with the usual cystomata. In this case this does not seem correct, since, as we have seen, the cysts have not the structure of usual ovarian cysts."

Our theory as to the origin of dermoid cysts explains how the various cells may have been scattered in the various parts of the ovary, so that the expression, "It seems as if the various elements developed from a growth of cells which were scattered throughout the entire organ," stands in harmony with our view. Marchand says further: "The explanation of the origin of such tumors meets with certain difficulties. The noticeable fact that these occur almost entirely in the generative glands, especially in the ovary, has caused the opinion that the various tissue forms owe their origin to a form of parthenogenetic development from the germinal cells (ova)."

It may be seen, in reviewing the numerous cases which we have quoted, that similar dermoid cysts, and very complicated ones too, occur in various parts of the body. That in the generative glands, especially in the ovary, such complicated tumors should develop, seems natural after our embryological review, and stands in harmony with our theory, for in the ligamentum latum near the ovary we find all the structures whose complicated embryonal development we have shown in Figs. 35, 44, 48, etc.

Marchand says further: "By others these tumors have been referred to the 'first formation' of the ovary, since in its earliest development it stands in close relation to the three blastodermic layers. It is said that parts of these various layers enter into the ovary and later go on to independent development." This is our view, and will be supported more fully by our subsequent discussion, which is concerned with the description of nine minutely studied dermoid cysts.

In order to make still clearer the question of mixed tumors, I group together the following, taken partly from Tillmanns :

As regards the tumors of the testicle, pure enchondromata are rare. Mohr has found eleven cases in the literature.

Chondromatous mixed tumors are found somewhat more frequently.

Osteomata result through ossification of a chondroma.

The formation of cartilage and bone has been also observed in adenoma, carcinoma, myoma, cystoma, and sarcoma.

Myomata in pure form are rare; more frequently they occur in mixed tumors as smooth or striated muscle fibres.

Rhabdomyomata have been described by Billroth, Rokitansky, Senftleben, Neumann, etc.

Myxomata are found as myxosarcoma, myxadenoma, and myxocystoma.

Sarcomata are relatively frequent.

Adenomata occur purely or as mixed tumors.

Adenocystomata occur generally as pure adenomata, at times with areas of cartilage and newly formed muscle fibres.

Cystadenoma mucosum is another form.

Cystadenoma atheromatosum s. epidermoidale (Langhans), with thick contents like that in skin atheromata, is found.

Simple and complicated dermoid cysts or teratomata are rare.

According to Eve, the cysts of the testicle originate, as a rule, from the rudiments of the Wolffian body found in the hilus testis.

The adenomata and cystomata originate generally *from the rete testis* (*the rete testis develops from the Wolffian body*).

" Almost all the tumors included under the name of ' cystoids, enchondroma, rhabdomyoma, cystosarcoma, and cystocarcinoma,' together with the mixed tumors of the testis, are found on exact examination to contain products of all three blastodermic layers" (Wilms). We shall later discuss the conclusion to which Wilms comes on the basis of this decidedly incorrect statement.

We therefore see that products of the ectoderm occur, as a rule, only in dermoid cysts and teratomata, and to a much less extent in the mixed tumors. No entoderm products can be present. It is clear that just as the mesodermal mixed tumors show the various mesodermal tissues in varying degrees, so may also the mixed tumors which are built of cells of both ectoderm and mesoderm show these resulting products in varying degrees. If ectodermal cells are displaced to any extent, so that their presence is observed through cutis-like tissue, hair, sebaceous glands, etc., we speak of dermoid cysts. If the displaced cells are, so to speak, located *in one part* of the organ concerned, and if they grow equally, and if the skin cells, as in the normal skin, and the sebaceous glands excrete their products, a cystic dermoid must result. Since the contents found in dermoid cysts are excreted by the so-called "derm" of the cyst, they must lie, when secreted, between the derm and the enveloping tissue of the organ or tissue in which the dermoid grows. The larger the amount of this secretion, the greater is the pressure and depression exerted on the surrounding tissue. If the mass of secreted matter reaches a fair amount, and if it causes in its circumference a tissue growth, and if it compresses the enveloping organ or tissue so that it is stretched and flattened out, we then have a cystic dermoid whose wall consists of so-called "skin," of granulation tissue, and of the tissue of the enveloping organ. The original group of displaced cells is found then only in one part of the so-called cyst wall, and it is this part which grows gradually for years, and in which are formed the hair, the sebaceous glands, and the other elements found on the inner surface of a dermoid cyst. The larger the amount of substance secreted, and the larger the number of products formed by the displaced ectodermal and mesodermal cells, the larger is the cyst.

If, on the other hand, the displaced cells *are not grouped in one part of the organs concerned*, and if, at the same time, the ectoderm cells are not present in too great number, there develops a tumor in which the various tissue forms grow into each other. Since the ectoderm cells do not form in such a case a so-called "derm," and since they cannot through their excretion bring about the formation of a cyst as above described, a tumor form results which is relatively solid and which seems to be of an entirely different structure—a so-called "teratoma."

We understand under teratoma only the tumors originating from displaced cells, and we may therefore divide the so-called "teratoid" growths into the following forms:

1. Mixed tumors.
2. Dermoid cysts.

3. Teratomata. (Solid tumors of complicated structure which, according to many authors, contain products of all three blastodermic layers.)

It is, of course, to be understood that all these forms are only mixed tumors. As said before, the observation of Wilms that so many of the testicular tumors contain products of all three layers is interesting, for it shows that the displacement of the two layers (ectoderm and mesoderm) through the Wolffian body and the Wolffian duct occurs in the testicle as well as in the ovary; in the ovary, however, these tumors occur more frequently in the form of dermoid cysts than in the testicle. This may be explained by the fact that in the female the Wolffian duct and Wolffian body lie at the hilus of the ovary as non-functionating organs, while in the man it forms the *vas deferens* and other functionating tubules.

To make still more positive the statement that cystadenomata of the ovary originate from the Wolffian body and displaced cells, I must repeat the fact that the adenomata and cystomata of the testicle develop mainly from the rete testis, which, as is known, *is formed from the Wolffian body.*

The so-called "mixed tumors" of the ovary may be grouped together in the following form. Of these I name only those which make a comparison with the tumors of the testicle clear.

Enchondroma and osteoma. In the majority of such cases we have, on the one hand, regressive changes—*i.e.*, of fibromata (?)—and, on the other hand, they are probably teratomata (Orthmann).

Cases of ossification of fibromata have been reported by Kleinwächter, Hasse, Loebel, Copeland, Coe, etc.

The formation of cartilage occurs seldom, according to Olshausen: one case is reported by Kiwisch, a second case by Kiwisch—*i.e.*, a fibroid with cartilaginous plates on the external surface—a case of Schröder, a fibroma with numerous islands of cartilage. Bone was also present.

Cystic sarcoma. The larger cysts are, as a rule, accidental combinations with a sarcoma, or they are primary neoplasms to which sarcomatous changes have been added. Then there are found, as in cases by Czerny, scattered areas of sarcoma in the wall (Heinrichs).

Myxofibroma.

Adenomyxocystoma.

Dermoid cysts, very frequent.

Solid dermoids or teratomata, very rare.

If we compare these tumors found in the ovary with those mixed tumors of the testicle, we see that in the testicle mixed tumors are found with a prevalence of the mesoderm products and with a very infrequent presence of ectoderm elements. That enchondromata and osteomata occur frequently in the ovary seems to be overlooked, because these, almost without exception, occur in combination with ectoderm cells—*i.e.*, as dermoid cysts and teratomata. This difference is explained, as I have already remarked, by the statement that the Wolffian duct and the tubules of the Wolffian body (not alone that part of these tubules which opens into the Wolffian duct, but also that part which is connected with the celom) lie as parovarium and paroöphoron at the hilus of the ovary, being regressive structures. On the other hand, the Wolffian duct in the man forms the vas deferens, and a part of the Wolffian body forms the head of the epididymis and the rete testis, and only a small part undergoes regressive changes, and this part has not, like the Wolffian duct, been in close contact with the ectoderm.

In ovarian dermoids and teratomata, ectoderm is present in large amount. Therefore we find here teeth—an occurrence in contrast to the conditions existing in the testicle. Teeth, as we have already shown, are only formed where ectoderm is present on a mesodermal base. In dermoid cysts the teeth are embedded in bone or in the wall of the cyst where no cartilage or bone is to be found; they may also lie in the cyst contents. Their number varies, even one hundred or more having been found in one cyst. The teeth lie, as a rule, on the inner surface of the cyst, and are rarely embedded within the wall—another fact which speaks for their origin as we have explained it, for ectoderm or cutis is found on the inner surface. A further interesting fact is that the teeth, in all cases which I have examined, *are always unilateral*, and, with perhaps one exception, among eleven cases which were examined for me by a skilled observer, *corresponded to that side of the body in which the cysts were found—i.e., in right-sided cysts were found right-sided teeth; in left-sided cysts, teeth of the left side.* The occurrence of teeth in dermoid cysts is not limited to the ovary alone, but, as we have observed, they have been found in dermoid tumors of the hypophysis, of the eye, in mediastinal dermoids, retroperitoneal dermoids, etc. The teeth may be either first or second teeth, and both forms may be found in the same cyst. They may be either molars, bicuspids, incisors, etc., and may represent the teeth of the upper or lower jaw.

The dermoid cysts of the ovary do not always take their origin from the ovary. If this is the case, the ovary may be entirely dilated by the tumor which has developed in it, or the ovary may be found only in one part of the cyst wall in cases where the dermoid cysts originated at the hilus and grew into the ligamentum latum. The dermoid cysts may develop in the ligamentum latum, and *the ovary takes no part in the formation of the tumor, but lies absolutely free*, showing, however, as a rule, various changes. This last fact speaks beyond doubt for their origin from structures which have not made their way into the ovary or which were not present in the ovary. The case of Switalski and our own theory make this possibility quite clear. This latter form, whereby the ovary is not affected, occurs more frequently than has been noted in the literature.

That the cells from which the dermoid cysts develop have been carried into the ovary by the Wolffian body finds a further support in the fact that several dermoids may occur in one ovary. Olshausen found in one case a large tumor which proved to be a proliferating cystoma with two dermoid cysts of the size of an egg separated by a considerable space from each other. In another case he found in one tumor three dermoid cysts side by side. Wilms describes a case where in one ovary five dermoid cysts were present.

The occurrence of dermoids in both ovaries is by no means rare; such cases have been frequently described, and it seems that this occurs in cases of dermoid cysts in perhaps twenty per cent of the cases. All these facts speak for some disturbance during embryonal development.

Among the other interesting structures found in dermoid cysts must be mentioned nails (finger nails), of which very fine specimens are to be found in the museum of the Anatomical Institute in Vienna. Olshausen says: "It should not be considered strange if nails belonging to the skin are frequently found in dermoid cysts, just as, in the sheep, wool has been found in dermoids, and in cows, hair, and in birds, feathers in dermoid cysts. The collection in the Gynecological Clinic in Halle contains a specimen of a dermoid cyst of a goose containing very numerous feathers."

The dermoid cysts are frequently combined with proliferating cystomata. As a rule, in addition to a dermoid cyst, a cystoma is found in the same ovary, but more frequently there are found in the wall of the dermoid cyst smaller or larger formations of the same character as in simple proliferating cystomata. These two forms are to be distinguished from those combinations whereby two separate tumors, the one a dermoid, the other a cystoma, are united through adhesion and perforation of the separating walls. The occurrence of a dermoid in one ovary with the presence of a cystoma in the other ovary is by no means seldom. Olshausen quotes a case of Flaischlen in which in the same ovary a cystoma proliferum, a dermoid cyst, and a sarcomatous degeneration of the connective tissue were present; the walls of the cyst were sarcomatously degenerated. A case of Unverricht showed in the left ovary the characteristic elements of a dermoid, and further red, spongy masses which were included as distinct nodules in connective-tissue capsules; this case presented a round-celled sarcoma. Tumors of the same form were found in the cervix, peritoneum, omentum, liver, and diaphragm. Although the tumors in these latter situations are to be considered metastases, the tumor in the cervix originated probably through the Wolffian duct in the same way as the main tumor in the ovary. That dermoids and teratomata should form metastases and undergo malignant degeneration into carcinoma, etc., is very natural, for they are nothing else than the cells of the patient and may, therefore, pass through the same changes as the normally situated cells of the body.

Olshausen says that the occurrence of teratomata in the ovary does not speak for the theory of parthenogenesis, which we will discuss later. He says: "We must not forget that teratomata occur much more frequently and decidedly in other parts of the body—for instance, in the sacral region, in the scrobiculus cordis, in the hard palate, etc.—where such an explanation (parthenogenesis) is impossible. It is therefore probable that in the formation of teratomata of the ovary we are dealing only with a fetal displacement of cells, so that there is no great *genetic difference between dermoids and teratomata of the ovary.*" He says also that any other explanation for the dermoids of the ovary than is given for dermoids of other parts of the body "makes it necessary to adopt *two entirely different theories as to their origin for seemingly like formations.*"

Since our explanation may be accepted without doubt, we possess a theory which stands in harmony with the various theories before mentioned in explaining the dermoid cysts and teratomata in other parts of the body—*i.e.*, all originate from a displacement of cells. An important fact which speaks for this event is the occurrence of these tumors in children, which, according to Olshausen, "even very long ago has led to their origin being referred *to the period of fetal development.* During childhood and up to puberty the dermoid cystomata are the most frequent form of ovarian tumors."

According to Olshausen, Pigné found, as regards the occurrence of these dermoid tumors in childhood, that in eighteen cases three premature infants and four full-term infants were affected; six times they were found in children under 2 years of age and five times in children under 12 years. "The fact that dermoids may occur at any period of life, together with the anatomical structure of these tumors, which compels a belief in a fetal formation, forces us to believe that dermoids may through decennia have a very slight growth, or may without growth remain very long, or even always, just as they were formed in the fetus" (Olshausen).

That the majority of dermoid cysts are observed during or after puberty is easily understood. The displaced cells are, as I have said, *the cells of the patient,* and possess the same characteristics as all the other cells of the body, and for that reason they evidence their greatest energy, as regards growth, during or after puberty. That they develop more energetically in the ovary may be understood, because they are in a position to grow into the free abdominal cavity without resistance. Their growth is further unhindered because they are not under the influence of the trophic nervous system and the normal resistance of other normally situated tissues, as is the case in those areas where cells develop in their normal situation. I quote the following from Orth because it furnishes in general a support to our view:

> "Just these complicated formations (teratomata) have awakened the view that we are dealing with an incompletely developed fetus, an inclusio fetalis, whereby it must seem strange that such an inclusion should be so frequently found in the ovary. Some cases might be considered as old ovarian gestations, if it were not that the same neoplasms occur in children and virgins. When we consider the intimate relations in which the developing genitalia stand to the external

and middle blastodermic layers, the development of simple and complicated dermoids could well be referred to a *displacement of cells*, the more so since no other explanation is possible for dermoids in other parts of the body, especially the so-called 'fissural dermoids.' We cannot then, however, understand why such tumors should not occur with the same frequency in the testicle. If we consider the already-mentioned relations to the adenocystomata, which develop directly or indirectly from the germinal epithelium (from the follicle epithelium), we must then come to the question whether or not the dermoids may be considered a product of the germinal epithelium (after Waldeyer). Germinal epithelia are virtual ova cells, and since it is known that in certain animals and also in double-sexed animals a development of non-fecundated ova occurs, a form of parthenogenetic development from ova—*i.e.*, germinal epithelium cells—might be thought of for the very complicated teratomata. It has been stated by various writers that the dermoids develop from a localized region of the ovary, and that the teratomata form a diffuse enlargement of the entire organ, as if the individual elements had developed from a growth of cells scattered throughout the entire organ (Marchand). But since a sharp division of the two forms is not possible, and *since teratoid formations are combined with adenocystomata, so may the cells for both forms of tumor be the same—i.e., the germinal epithelia.* At any rate, this view is only an hypothesis and does not suffice to fully explain the cause, for it must remain strange that such a parthenogenesis occurs *already before puberty;* and besides, it remains to be decided why the germinal cells take on such an abnormal development. I am of the opinion *that already in the earliest development the formation for these neoplasms is laid down.*"

The teeth found in dermoid cysts furnish in all probability a support to our explanation of the origin of these tumors. Olshausen says: "The teeth have, like the teeth in the mouth, a crown sloping toward the median line of the body, so that we can recognize from the teeth of the cysts the side of the body to which the latter belong. The docent in dentistry at Halle, Prof. Holländer, called my attention to this fact and furnished me frequently with proofs of the correctness of this statement." Olshausen put him frequently to the test, and Holländer was always able to say, on examining the teeth, from which side the cyst had been removed. In twelve cysts in which the teeth were examined for me by Dr. Waldberg, D.D.S., Northwestern University, never were *right and left teeth found in the same cyst.* In these cases it was found that the teeth were, in six tumors, of that side from which the tumor was removed. In five cases no history could be found. Waldberg, in determining the teeth, was not aware of the purpose of the examination, and only later did I compare his statement with the history of the cases. One case, however, containing two right-sided teeth, was removed, according to the history, from the left side. This large hour-glass tumor extended far over to the right side, where a dermoid of the other ovary was also present. Since the smaller portion of this hour-glass cyst was united to the main tumor by only a thin pedicle, I consider it possible that it originated from the right side and later became adherent to the cyst of the left side. The interesting fact, however, is that in all these cysts, among which three contained six or more teeth which could be recognized as right or left, never were right and left teeth present in the same tumor. The report of Waldberg reads as follows:

"I examined in the Clinic Olshausen the teeth of four dermoid cysts in which cases Dr. Bandler determined from the history the side to which these tumors belonged, and his statement and mine corresponded in three cases as regards the side of the mouth to which these teeth would have belonged. In one case, in the Clinic Abel, I found at the end of a bone, covered with skin, eight firmly fixed teeth, evidently united to the above-mentioned bone. They were permanent or second teeth. Six of these, fully developed, were positively normal molars and bicuspids of the left side; the first were molars of the lower jaw, the latter bicuspids of the upper jaw (this cyst, according to the history, was removed from the left side). My examination in the Clinic Chrobak gave the following results: Specimen No. 31 (dermoid cyst containing teeth, bone, and mucous membrane) showed one left upper bicuspid tooth. Specimen No. 30 showed no teeth which could be definitely determined. Specimen No. 110 showed one cuspid or a malformed bicuspid, probably belonging to the right side. Specimen No. 133 (multilocular cyst) showed one left first bicuspid situated in the dividing wall.

"I found the following in the examination of four specimens in the Pathological Institute in Vienna: Specimen No. 2315 showed one left bicuspid; one left upper first molar with an extra 'disto-lingual cusp,' which, according to the theory of Black, is in nearly all cases hereditary; one left lower first and one left lower second bicuspid; eight teeth with noticeable 'mamillons,' in which I was not able to determine the side. Specimen No. 4251 showed the teeth to be very calcified; one first upper right molar very distinct. Specimen No. 2876 showed two upper molars belonging to the right side. One specimen marked 'teratoma ovarii' contained over forty teeth, one bicuspid very clear and several other teeth, all being in my opinion left-sided, without showing, however, absolute criteria.

"In all these cases I found the identified teeth partly free in the tumor or connected with the mucous membrane or the bone; others I found firmly united to the mucous membrane or the bone. There were present various pathological changes, such as the failure of union of the enamel, carious points, or the absorption of roots. In none of the teeth identified by me did I fail to find one or other of the evidences which are necessary in deciding to which side teeth belong—evidences which were very distinct, as was found by a thorough comparison with the description and drawings found in the 'Dental Anatomy' of Black, my former chief."

Unfortunately I could find in the Clinic Chrobak in only one case a history stating the side of the tumor. No. 133 was removed from the left side. In the Pathological Institute only one specimen was marked as regards the side. No. 2315 was a left sided cyst. Only further investigation can prove whether this fact holds good in all cases. I find it, however, very remarkable that the teeth in all these cysts were always of one side.

The following portion of this article is concerned with the description and the microscopical examination of nine dermoid cysts.

Case I.—The tumor of the right ovary is 7 centimetres long and 5½ centimetres wide, rather long in shape, and consists of two parts, a solid and a cystic. The solid portion rests upon the cystic portion at one end of the tumor like a cap. In section the solid portion proves to be the ovary with several cystic structures, of which the largest has the size of a cherry pit. The cystic portion, situated on the side corresponding to the hilus of the ovary, contains a thick, cheesy matter mixed with hair. The cyst wall is of the thinness of paper on one side and almost transparent, while on the other side it forms the thick, so-called "dermoid prominence." This forms an elevation above the inner surface which is 2½ centimetres wide, 4 centimetres long, and of the thickness of a finger, being closely covered with hair. This prominence itself is not entirely solid, but shows in section several cystic structures. In other parts of the cyst wall are seen blonde hairs which seem to grow at these points, but a microscopical examination shows that they have not originated in the wall, but, extending from the prominence, have become united with the adjoining wall and are covered with granulation tissue.

The tumor of the left side consists of a decidedly enlarged ovary, 7 centimetres long, 3½ centimetres high, 2½ centimetres thick, and of the tube of the thickness of a finger, which has in most part enveloped the ovary and is closely united with it. The surface of the ovarian tumor, which in great part feels solid, is uneven and shows at various points nodular cystic projections. In the middle of the convex surface is a tear 2½ centimetres long, resulting through the bursting of the cyst filled with thick contents. Section through the ovary shows it to be filled with a number of larger and smaller cysts containing contents which, after hardening in alcohol, show a cheesy consistence. The character of the cysts corresponds microscopically to those found in the ovarian tissue of the other side, although in this case they have reached a larger size. Section through the tube shows that its increase in size is the result of a thickening of the mucous membrane, as well as the thickening of the wall. The fimbrian end, as such, is not preserved, but is firmly united to the ovary.

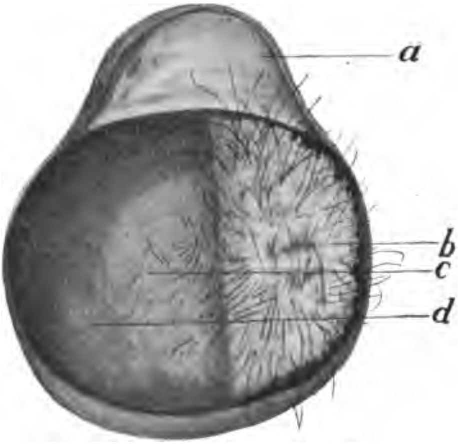

FIG. 62.—*a*, remains of ovary; *b*, "dermoid prominence" covered with hair; *c*, part of the cyst wall, still lined with squamous epithelium; *d*, translucent thin cyst wall lined with granulation tissue, being a direct continuation of the ovarian substance.

Microscopical Examination.—Section through the ovarian tissue of the right-sided tumor shows that the normal structure is almost preserved to a considerable extent. In the parenchymatous layer are numerous resting and growing follicles. At several points corpora albicantia are present, and the vessels have a normal character. The cysts prove to be follicle cysts; of especial interest is one, the size of a cherry, which shows at one point a normally embedded ovum.

The surface of the dermoid prominence (*b*, Fig. 62) is covered by stratified squamous epithelium which covers the surface in a rather even course, showing only at certain points rather deep depressions into the underlying tissue, so that the stroma between these depressions bears some resemblance to skin papillæ. It should be mentioned that we are not dealing here with real papillæ, as may be seen from the entirely different arrangement of the vessels. Likewise the stain for elastic fibres shows that the latter do not, as in normal skin, send fine branches into the papillæ, but are here divided as in the rest of the tissue; we are dealing, therefore, here, not with papillary elevations of the underlying tissue, but with more

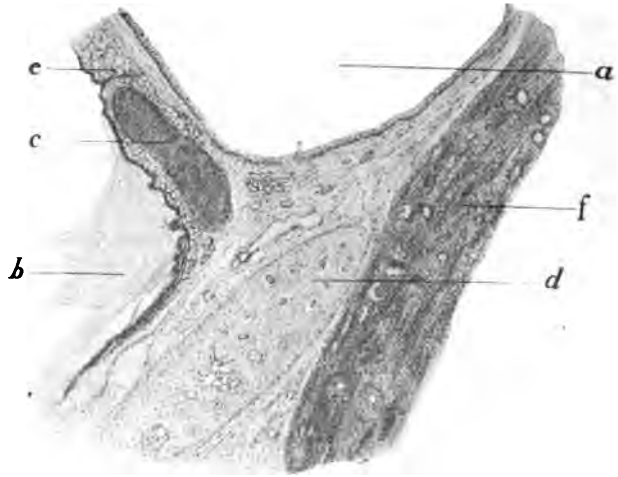

FIG. 63.—*a*, cyst lined with stratified cylindrical and ciliated epithelium; *b*, cyst lined with stratified cylindrical and ciliated epithelium which shows papillary excrescences; *c*, cartilage; *d*, bone with bone marrow and Haversian canals; *e*, adenomatous structures; *f*, ovarian tissue forming the base of the "dermoid prominence."

or less deep depressions of the epithelium. The layers of epithelium are in this specimen less numerous than in the normal skin, yet a distinct stratum germinativum may be distinguished. Above it are two to three layers of smaller cells, which are followed by several layers of larger, smoother cells. The surface layer is being cast off and corresponds to the horny layer.

The underlying tissue consists mainly of fibrillary connective tissue, between which connective-tissue cells are irregularly distributed. Vessels are not present to any considerable extent and evidence no peculiarity. Separated by this layer from the epithelium lies an extensive area of acinous (sebaceous) and sweat glands. The latter are dilated and lined with the cylindrical epithelium. The epithelia are very broad and have a nucleus situated at the base and a granular cell body. That portion of each cell directed toward the interior is round and shows a border which seems to represent cilia, but this cannot be determined positively. The cells resemble the cells lining the kidney tubules and are separated by a membrana propria from the surrounding tissue. Between these glands and the sebaceous glands are found, in addition to hair, numerous bundles of smooth muscle fibres cut transversely, and also numerous longitudinal and transverse sections of hairs and hair follicles. Two glandular structures are present, showing a cystic character, and situated near the base of the prominence.

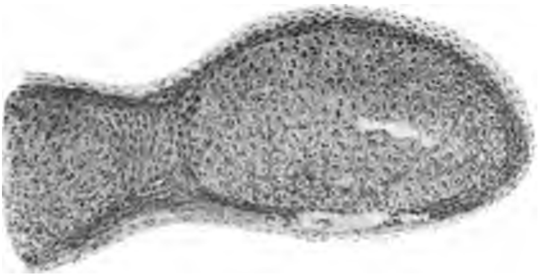

FIG. 64.—Cartilage (*c*) in dermoid prominence, Fig. 63.

The boundary between these two large cysts is formed by a piece of cartilage and a group of small glandular structures. One cyst (*a*) is lined with stratified ciliated epithelium. The lowest layer forms a continuous row of very dark nuclei; the upper layers consist of somewhat longer cells, and the uppermost layer shows in part distinct cilia, between which is found the same secretion with which the cyst is filled. The other cyst (*b*) is lined with stratified epithelium which is also furnished with distinct cilia. The inner wall of this cyst, in contrast to the other, shows numerous small projections into the interior. They correspond fully in their structure to the projections in a cystadenoma papillare. In this cyst the contents, on staining, prove to be the same as in cyst *a*. Immediately under this cyst wall is found a glandular layer which seems to go out from the epithelium of the cyst, and which surrounds a piece of cartilage (*c*) on three sides.

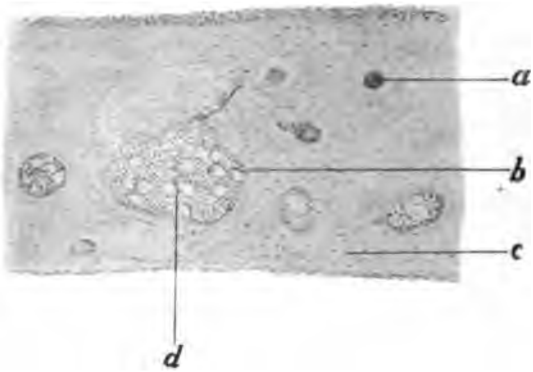

FIG. 65.—Bone (*d*) in Fig. 63. *a*, Haversian canals; *b*, marrow; *c*, bone substance.

The glands are small and lie so closely together that scarcely any interglandular tissue is present. The epithelia are rather broad cylinder cells somewhat narrower toward the lumen, so that almost the entire interior is occupied by the epithelia and scarcely any lumen is present. The nucleus of the cells is small and lies near the base; the protoplasma is finely granular and scarcely takes on the stain. In some of the wider glands it seems as if some beaker cells were present. If a comparison is to be made with any normal gland, these structures in form and arrangement resemble very much the glands of the mucous lining of the stomach.

Near these structures are found other glandular forms which differ considerably. They are either long or quite dilated. The epithelia are small and cubical. These ducts are surrounded by a distinct longitudinal fibrous (muscular?) tissue layer. The piece of cartilage (*c*, Fig. 63) is normal hyaline cartilage surrounded on one side by fibrillary connective tissue, while on the other side the above-mentioned glands are in close contact with it.

Under the piece of bone (*d*, Fig. 63) at the base of the dermoid prominence is found a rather large layer of ovarian tissue, consisting of the usual connective-tissue cells with vessels and showing no evident changes. In addition are found several follicles and a corpus luteum with regressive changes. The piece of bone shows the character of normal bone with marrow substance and has Haversian canals. Between the sebaceous glands of the surface and the cyst (*a*) is a tissue containing numerous very small nuclei and also pyramidal cells rich in protoplasma with a central nucleus. The basis of this tissue is reticular. This is a tissue which has been described by Wilms as glia tissue with ganglion cells, and which he finds in all ovarian dermoid cysts.

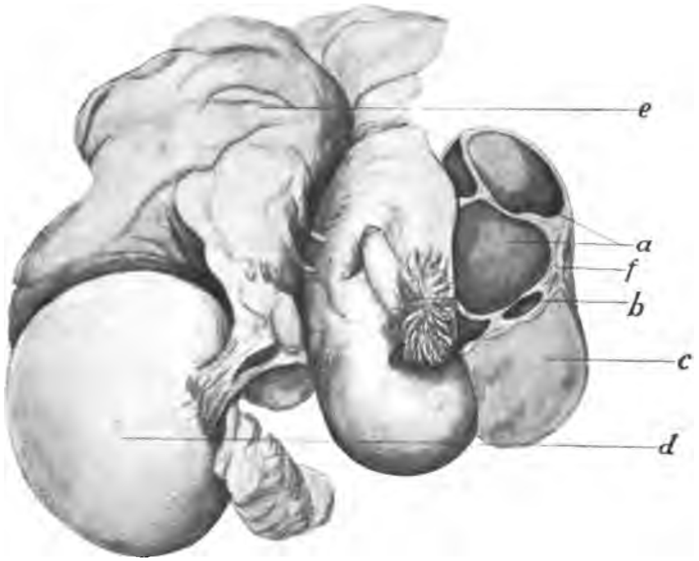

Fig. 66.—Ovarian and intraligamentous cystadenoma proliferum. *a*, cysts in the ovary with colloid contents; *b*, tube with fimbrian end; *c*, cyst of the ovary with cheesy contents; *d*, thin-walled pedunculated cyst connected with *e*, with colloid contents; *e*, intraligamentous cyst connected with hilus of ovary and showing papillary excrescences; *f*, ovarian tissue.

The other ovary contains a series of smaller and larger cysts, which prove microscopically to be follicle cysts. Dermoid structures or cysts lined with ciliated epithelium could not be found.

CASE II.—This tumor is composed of various parts, and we can distinguish the cystic degenerated ovary with an attached portion of the tube, showing its fimbrian end, from a large cystic tumor whose inner surface is partly smooth and partly lined with papillary excrescences. Attached to the latter is a pedunculated tumor with a very thin, translucent wall and with colloid contents (Fig. 66).

The cyst lined with papillary structures was intraligamentous and was so fixed by adhesions that it ruptured on removal and was rather torn. With the exception of one cyst in the ovary which contained a thick, cheesy substance, the other cysts contained colloid contents. In considering the cysts situated in the ovary, it may be observed that very little of ovarian tissue remains, for the walls of the cysts lying externally are of the thickness of paper and correspond to the albuginea of the ovary. The cysts, of which the largest in the hardened specimen is still 3 centimetres long and 3½ centimetres wide, are separated from each other by extremely thin and translucent wall's. The intraligamentous tumor stands in most intimate union with the hilus of the ovary and is very large. The same is true of the round, pedunculated tumor which is connected closely with this latter cyst.

Microscopical Examination.—The dividing wall between two cysts (*a*) consists of a fibrillary connective tissue which is very poor in cells. Below the lining epithelium is a layer of very loose tissue followed by another layer containing numerous cells. Finally, under the latter is a layer showing myxomatous degeneration and containing numerous vessels whose walls likewise show myxomatous changes.

The epithelial lining consists of an exceedingly distinct stratified epithelium which runs partly an even course, but shows at other points distinct projections into the interior of the cysts. Under this ciliated epithelium at certain points are found bundles of transversely cut smooth muscle fibres.

The wall of the intraligamentous cyst (*e*) consists of a wavy, fibrillary connective tissue, which toward the inner side is poor in cells and externally is firmer and richer in cells. The inner wall is lined with a stratified ciliated epithelium which sends projections into the interior of the cyst. In the amorphous contents of the cyst are seen thrown-off cylinder cells with distinct cilia which are partly retained and preserved while other cells are degenerated. The contents of the cyst consist, therefore, of mucus secreted by the epithelia and of the destroyed epithelia themselves. It is evident that the epithelia were engaged in very active growth and in continued degeneration and regeneration.

The papillary excrescences of the cyst (*e*) consist of a connective tissue rich in cells, showing irregular prominences and projections as well as depressions. These are covered in part by a low and in part by a high epithelium with a nucleus near the base. The epithelium is partly ciliated, but in most part shows beaker cells and is everywhere secreting actively. The epithelium grows more energetically than the underlying tissue, so that many depressions of the form of the *glands of Lieberkühn* are present. A myxomatous degeneration of the surface as well as of the underlying tissue is present at many points.

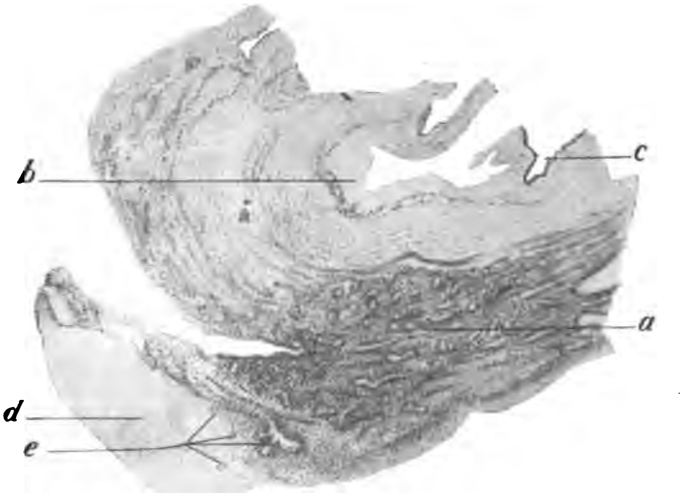

FIG. 67.—Section through the hilus ovarii near the prominence. *a*, ovarian tissue with hilus vessels; *b*, regressive corpus luteum; *c*, passage lined with squamous epithelium; *d*, fibrous new tissue; *e*, epithelial ducts (rests of the Wolffian body).

The contents of the cysts (*d*) are, through hardening in alcohol, of a firm consistence; the wall is so thin that scarcely anything can be seen in sections.

CASE III.—The tumor consists of the enlarged ovary and the therewith connected unchanged tube with its fimbrian end.

The ovary has the size of a hen's egg. In section it is seen that it consists of a cyst space with a wall one-half centimetre thick, which wall represents the remains of the ovarian tissue. As is the case with the outer surface of the tumor, the inner wall is fairly smooth, with the exception of an area corresponding to the situation of the uterine end of the tube, where the so-called "dermoid prominence" is present, being 3½ centimetres long and about 1½ centimetres high, projecting into the interior of the cyst. From this prominence extend into the cyst a large number of long, blonde hairs, the contents of the cyst consisting of the well-known dermoid cheesy substance mixed with hair. After this prominence was removed for microscopical examination, it was seen that in the cut wall of the cyst were several spaces or depressions, about two centimetres deep, from which also hair was growing.

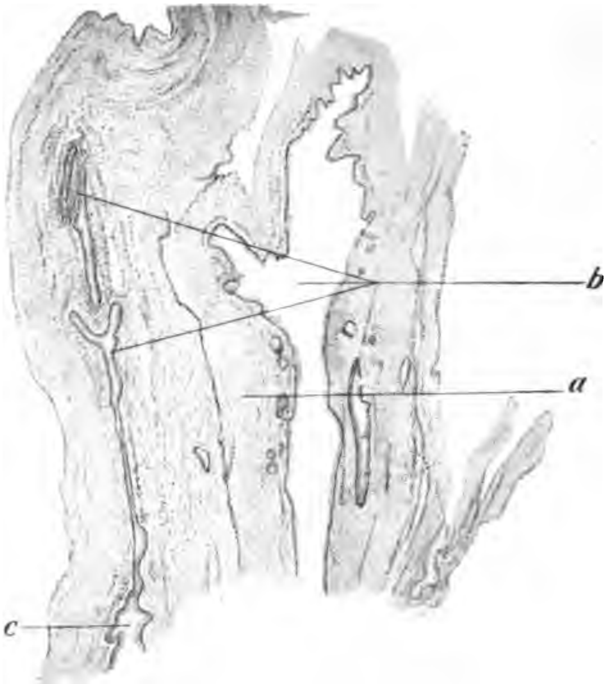

FIG. 68.—Section through a recessus or passage in the wall of Case 3. *a*, connective-tissue stroma; *b*, passages lined with squamous epithelium; *c*, a passage dividing into two parts.

The outer wall of these accessory spaces is very thin. The remaining portions of the entire cyst wall showed no peculiarities on section.

Microscopical Examination.—Sections through the wall of the cysts at the borders of the prominence in the hilus of the ovary show the ovarian tissue to be quite normal. The vessels are present in the usual number; the connective-tissue stroma shows many cells. Externally there appears a rather decided increase of connective tissue, while the cells have disappeared. In this fibrous formation are found sections of five ducts lined with a cubical epithelium, which must, from their position and form, be certainly considered remains of the Wolffian body (Fig. 67). The same form of ducts is found in the prominence itself.

Sections through the wall of the cyst at the edge of the prominence through the above-mentioned recesses show the stroma of the wall to be composed of a wavy, fibrous connective tissue, poor in cells, which may be considered as remains of ovarian tissue. Here we see passages entering to a considerable distance into the tissue of the wall; they are lined with stratified squamous epithelium. These passages often divide into two or three smaller passages (Fig. 68).

Near these passages are seen at certain points transverse and oblique sections of hair follicles. Other products of ectoderm, such as sebaceous glands, are not present near these passages. Fig. 69 shows such a passage by strong magnification, and we express the belief that a point such as *b* may be the beginning of a tooth formation.

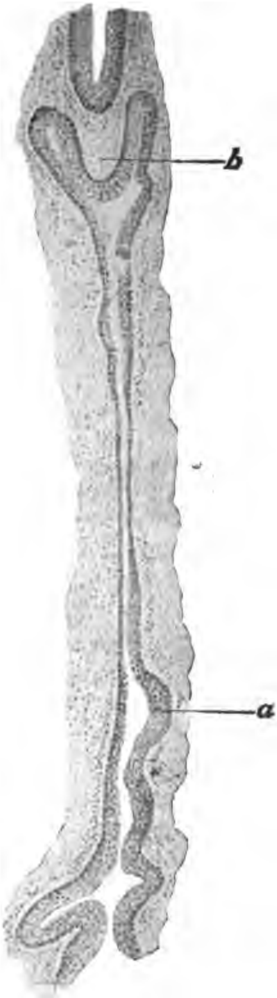

FIG. 69.—Epithelial passage (*c*), Fig. 68, strongly magnified. *a*, stratified squamous epithelium; *b*, division of the duct (tooth formation ?).

Section through the dermoid prominence shows it to be united to the ovarian tissue by a pedicle. The ovarian tissue forms the base of the prominence (Fig. 70).

The prominence is covered with squamous epithelium which at certain points sends epithelial depressions into the underlying tissue.

On the right side of the prominence the squamous epithelium passes over the pedicle to the inner surface of the ovarian tissue which forms a part of the inner surface of the cyst. On the other side the squamous epithelium (*b*) goes over into a distinct ciliated epithelium (*c*), where it shows depressions lined with a stratified cylindrical epithelium containing beaker cells. On the pedicle it continues as stratified cylindrical epithelium, where a group of acinous glands (*h*, Fig. 70) have been given

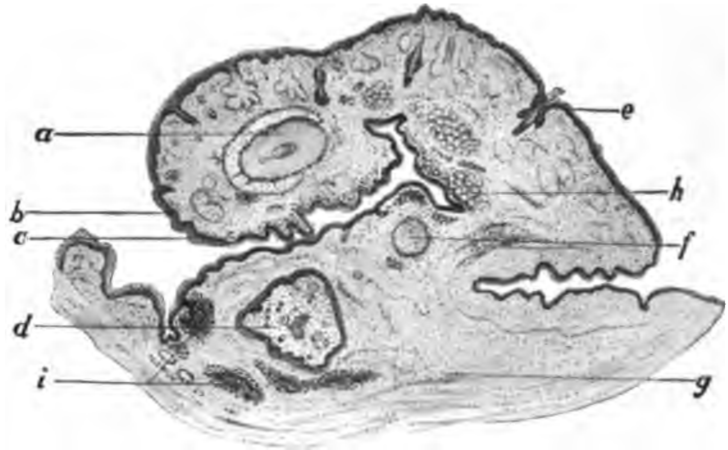

FIG. 70.—Section through dermoid prominence of Case 3 (explained in text).

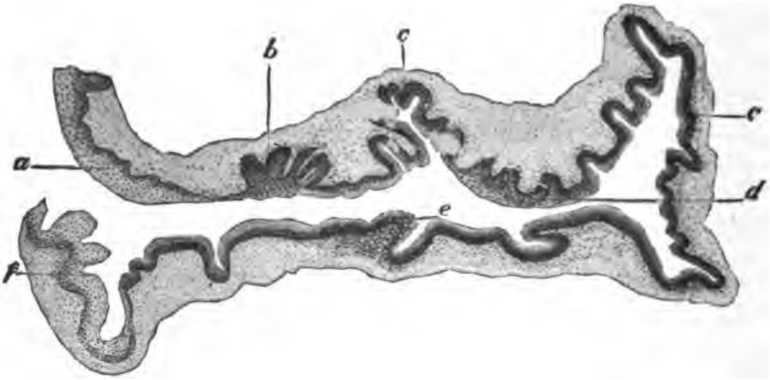

FIG. 71.—Transition of epithelium (squamous) covering the prominence in its course over the pedicle upon the ovarian basis (*g*) of the prominence (*b*, *c*, *h*, Fig. 70). *a*, squamous epithelium of the prominence (*b*, Fig. 70); *b*, cylindrical epithelium with glandular depressions; *c*, ciliated cylindrical epithelium; *d*, squamous epithelium; *e*, projections (papillary) with stratified cylindrical epithelium; *f*, squamous epithelium on the base (ovarian) of the prominence.

off. These individual glands are lined with a cylindrical transparent epithelium with a distinct nucleus lying at the base. These glandular structures correspond fully with the glands which in Fig. 63 were described as originating from the cysts (*a*, *b*).

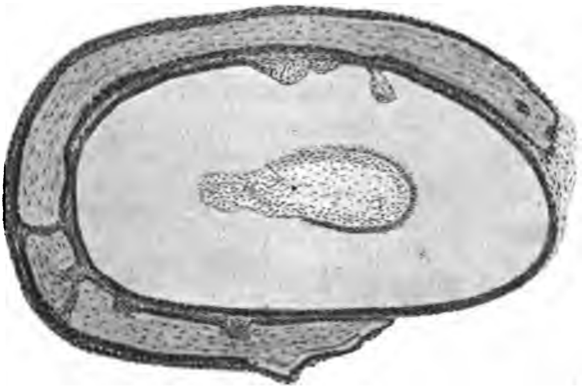

FIG. 72.—Section through tooth *a* Fig. 70, strongly magnified.

Further on, where the covering squamous epithelium of the prominence goes over upon the ovarian base, it has changed to a stratified ciliated epithelium (*c*, Fig. 71). In the prominence are found under the epithelium numerous sebaceous

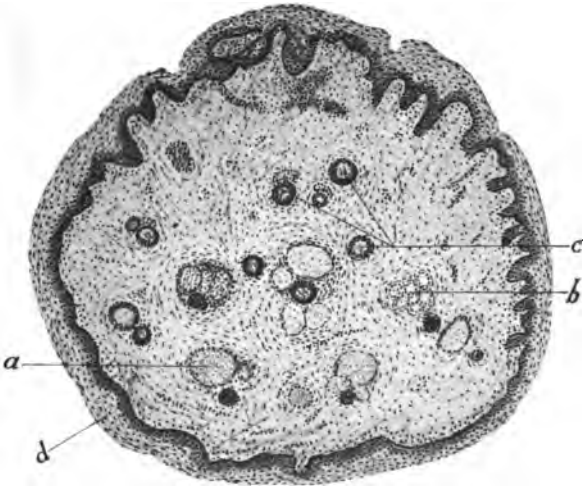

FIG. 73.—Nodule *d*, Fig. 70, strongly magnified. An island surrounded by squamous epithelium and containing sebaceous glands (*a*), sweat glands (*b*), and transverse sections of hairs (*c*).

glands, the above-mentioned acinous glands, fat tissue, fibrillary connective tissue, and a transversely-cut piece of bone (*a*, Fig. 70) which is surrounded by a connective-tissue layer, which in turn is surrounded by another layer of bone which shows at various points septa of connective tissue.

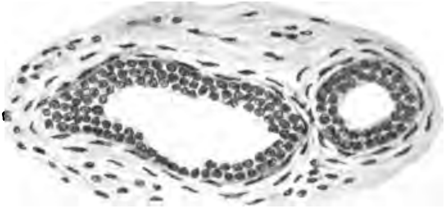

FIG. 74.—Epithelial ducts, like Wolffian ducts, under the epithelium of the pedicle, Fig. 70.

Around this outer layer of bone is a thin layer of connective tissue. The interior of this bone *shows no Haversian canals*, but, on the contrary, shows radial striation, as is found in the substantia eburnea of the teeth, so that there is no doubt that we are dealing here with a transverse section of a tooth.

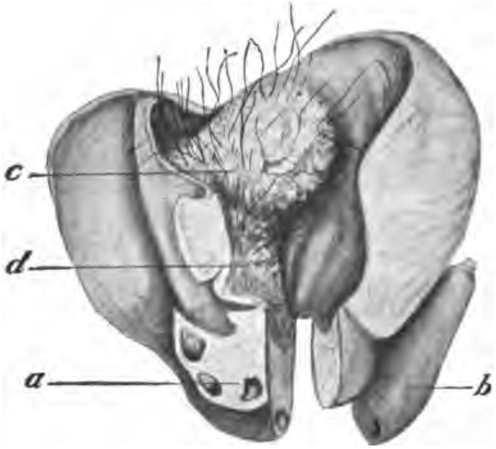

FIG. 75.—Dermoid cyst of Case 4. *a*, ovarian tissue containing small cysts; *b*, tube; *c*, dermoid prominence with hair; *d*, inner cyst wall lined with epidermis and also showing hairs.

At various points are found groups of round cells (*i*) and various bits of cartilage (*f*). In the pedicle, where the covering is composed of stratified cylindrical epithelium, are seen depressions which go over into the above-mentioned acinous glands (*h*, Fig. 70). Here are found single and grouped ducts lined with cylindrical epithelium, which are identical with the above-mentioned remnants of the Wolffian body (Fig. 74).

At the base of the prominence in the ovarian tissue lies the nodule *d*, which is covered with squamous epithelium. In the nodule are sebaceous glands, sweat glands, and hair. Under this nodule is found a gland duct resembling that in Fig. 74, which is lined with simple and stratified epithelium. The epithelium appears to possess cilia, but they cannot be positively proven. Under the nodules are islands of round-celled lymphadenoid tissues (Fig. 70, *i*).

CASE IV.—This tumor has the size of a goose's egg. The outer surface is quite smooth, there being at certain points broad, firm adhesions which unite the tumor to the uterus and the intestines. In section through the tumor it is seen that that part situated near the fimbrian end of the tube presents quite a retained portion of ovarian tissue with several cysts and follicles. The dermoid cyst is seen on the under surface and shows in its interior a large extent of epidermis-like tissue. On the one side a cyst the size of a dove's egg was found between the ovarian tissue and the dermoid wall. This resembles the recesses which were described in the previous case, only that this recess is much larger. The contents are again the well-known cheesy material mixed with hair. On the inner wall is seen the elevated "dermoid prominence" covered with hair. It is seen that this cutis-like covering extends over a greater portion of the cyst interior than in the previous cases, and hair is therefore found in a large area of the inner wall. Teeth or bone are not macroscopically present.

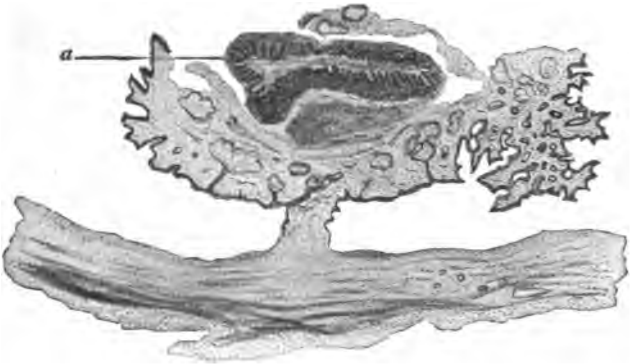

FIG. 76.—Section through dermoid prominence of Case 4. Description in text.

Microscopical Examination.—The thin cyst wall at a distance from the prominence consists of fibrous connective tissue with numerous vessels, especially in the middle layer of the wall.

The inner surface is lined with a very remarkable tissue rich in cells which by weak magnification have the appearance of squamous epithelium. Strong magnification shows this layer to consist of rather large cells with large nuclei, but a sharp boundary to the cells is not present. The superficial layer seems to be covered with long giant cells, which toward their base become narrower and at their other end are much widened. In the external fibrillary tissue follicles are still present, so that it is certain that this wall is composed of ovarian tissue. The above-mentioned cell lining must be considered as newly-formed granulation tissue.

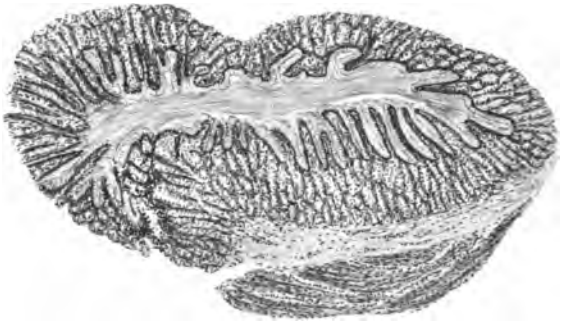

FIG. 77.—Glandular structure resembling gastric mucous membrane. Strong magnification of *a*, Fig. 76.

The dermoid prominence is covered by stratified squamous epithelium sending at certain points deep depressions into the underlying tissue. At numerous points are seen the excretory ducts of the sebaceous glands passing through the squamous epithelium up to the surface. At one point the covering of squamous epithelium is interrupted, and there is found a zone of strongly infiltrated round-celled tissue which has lifted off the squamous epithelium and given this area the appearance of an ulcer. On the base of the prominence the squamous epithelium passes over to the inner surface of the cyst wall in the form of squamous epithelium, while on the other side the covering changes to the above-mentioned form of granulation tissue.

The stroma of the prominence consists of a wavy, fibrillary connective tissue with numerous cells, sebaceous glands, many hairs, fat, and cartilage which is changing to bone. In addition is seen a very remarkable glandular structure in whose interior project a number of villi (*a*, Fig. 76).

These villous projections are covered with epithelium consisting of long, narrow cells with nucleus at the base. They are surrounded by a gland layer consisting of glands cut longitudinally and transversely (Fig. 77), forming narrow tubules lined with the same epithelium as has been described in Fig. 63, *e*, and in Fig. 70, *h*.

The wall which forms the base of the dermoid prominence consists of ovarian tissue with characteristic twisted vessels; follicles could not be found. At one point is seen a fairly long cyst of triangular form. The lining epithelium of this cyst is stratified cylindrical and secretes an amorphous substance, the upper layers of this epithelium being partly thrown off. Although cilia could not be positively recognized, it is probable that such were present.

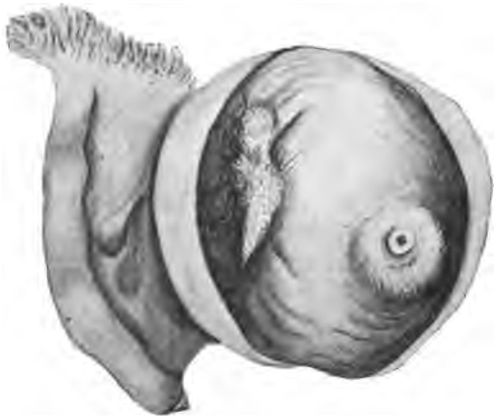

FIG. 78.—Dermoid cyst of the left ovary of Case 5. This dermoid prominence reminds one of a mamma with mammilla.

CASE V. *Bilateral Dermoid Cysts.*—The cysts are about the size of a fist, being nearly of the same size. The inner surface of the cysts is smooth, with the exception of those points where the dermoid prominences were found. It must be mentioned that in each of these cysts two prominences were recognized.

The contents of both cysts were alike. In a section through the dermoid prominence of one cyst was found a tooth-like structure of irregular form. In microscopic sections no other bone elements were found.

Microscopical Examination.—The dermoid prominence is covered with squamous epithelium and shows pointed projections. The underlying layer contains a large number of sebaceous glands, hair, and hair follicles. Fat tissue in large amounts is present, in which are found groups of yellow pigmented cells with distinct nuclei. At the base of the prominence is a cyst the size of a pea (Fig. 79).

This cyst is lined with a stratified epithelium showing cilia at certain points, and sending distinct projections of a papillary character into the interior of the cyst. Around it are epithelial structures forming small glands, which are lined with a cylindrical epithelium with transparent protoplasm. This cyst is entirely surrounded by a layer of muscle fibres and muscle bundles showing partly an arrangement into a longitudinal and circular layer (Fig. 79, *b*).

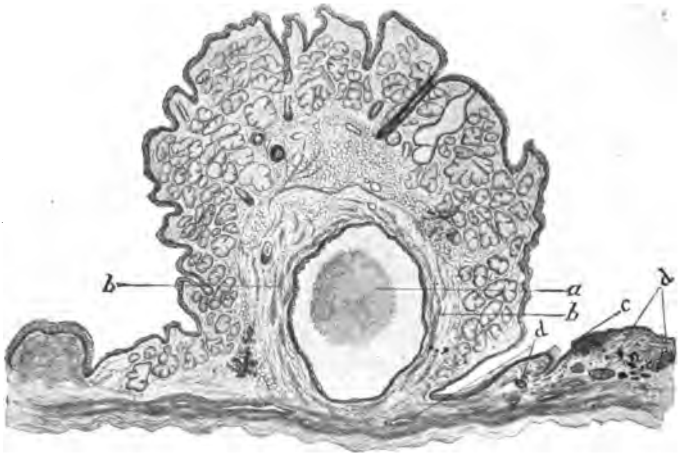

FIG. 79.—Section through dermoid prominence of Case 5, right side. *a*, cyst with papillary projections and ciliated epithelium and glandular offshoots; *b*, longitudinal and circular muscle layer about cyst *a*; *c*, ciliated epithelium on the interior of the dermoid cyst; *d*, glandular offshoots of the ciliated epithelium (*c*).

On the one side the squamous epithelium covering the prominence passes over upon the ovarian base as stratified and simple ciliated epithelium, from which glands pass off into the ovarian tissue (Fig. 79, *c*). On the other side the squamous epithelium passes over into a stratified ciliated epithelium. As regards the origin of the cyst *a*, it is seen that on the inner surface of the dermoid cysts the ciliated epithelium is connected with glandular structures (*c* and *d*, Figs. 79, 80) which are partly lined with a stratified epithelium also showing cilia, and partly with a simple flat epithelium evidently compressed by the secretion. In the secreted contents of these little cysts or glands are found cells with a clear protoplasm and with a distinct central nucleus. From this point (see Fig. 80) these glandular structures may be followed with increasing size up to the large cyst *a*, Fig. 79, so that the latter, situated in the middle of the dermoid prominence, certainly stands in relation to the ciliated epithelium which covers partly the dermoid prominence and which lines the dermoid cyst. There is in addition a complex of closely grouped glandular structures lined with cylindrical epithelium, in various parts of the dermoid prominence, which, with a little fantasy, resemble the structure of a thyroid gland. One area is exceedingly rich in cells of a spindle shape, and others resemble giant cells, so that this area resembles a sarcomatous nodule.

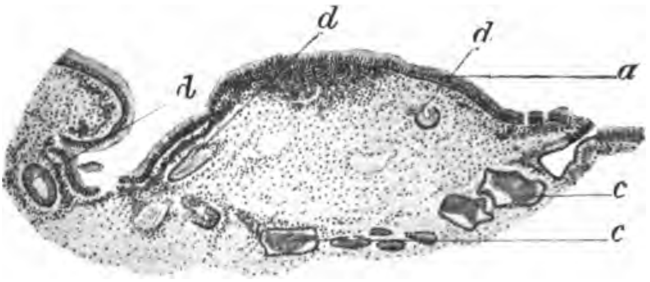

FIG. 80.—Points *c* and *d*, Fig. 79, strongly magnified. *a*, ciliated epithelium; *d*, glandular offshoots lined with cylindrical and ciliated epithelium; *c*, glandular offshoots lined with flat epithelium.

The dermoid prominence in the cyst Fig. 78 bears quite a resemblance to a mamma in miniature.

This prominence contains so many structures that we must first describe its appearance under weak magnification. The surface is covered with stratified squamous epithelium showing thin, thorn-like prominences. Below it are numerous sebaceous glands, much fat tissue, and many hairs. At one point of the surface is a series of villi arranged in a semicircle and opening like a glandular structure upon the surface. This glandular structure extends through the centre of the entire prominence, ending at *d*, Fig. 81, where the lining consists of cylindrical epithelium, and at *c* an area containing very peculiar cells. This area *c*, and the area *b* lying in the ovarian tissue which forms the base of the prominence, as well as the glandular structure *d*, are surrounded by several layers of muscle fibres running in various directions.

Microscopical examination by strong magnification of the glandular structure *d*, Fig. 81, shows it to be connected with the structures *c* and *b*. In its interior is a space or duct which runs up to the surface of the dermoid prominence. At the opening the above-mentioned villi resemble in their arrangement and structure *the glands of Lieberkühn.*

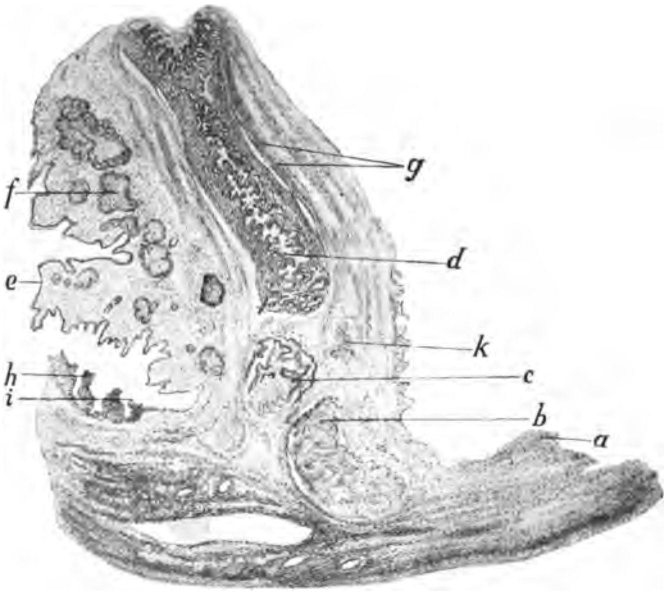

FIG. 81.—Dermoid prominence from cyst, Fig. 78. *a*, ovarian tissue with many follicles; *b* and *c*, glandular structures described in text and in Fig. 83; *d*, glandular structure with common duct and surrounded by a double muscle layer, *g*; *e*, stratified squamous epithelium going over at *i* into cylindrical epithelium; *h*, prominences consisting of granulation tissue; *k*, glandular structure resembling "thyroid gland"; *f*, sebaceous glands.

This outlet or duct is lined further down with a high cylindrical epithelium (ciliated epithelium?) which sends depressions in all directions. This duct is surrounded by a broad layer of tubular glands which lie so close together that scarcely any interglandular substance is present. The small amount of interglandular substance is a very delicate connective tissue.

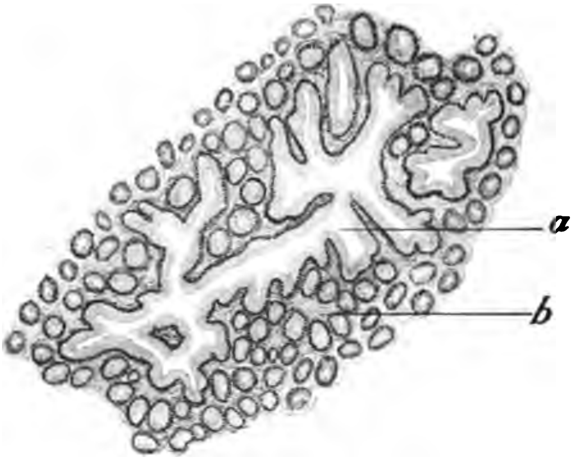

FIG. 82.—The "common duct" of Fig. 81 strongly magnified. *a*, the duct; [*b*, the surrounding glands.

Between these glands at various points are found groups of round cells which have been called "Peyer's plaques," in order to carry out a wished-for resemblance to the intestinal mucous lining. Around this entire glandular structure are

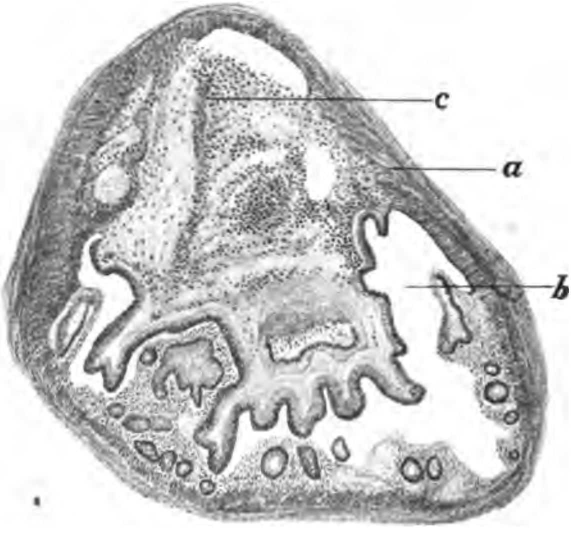

FIG. 83.—The glandular area *c*, Fig. 81, strongly magnified. *a*, double layer of muscle fibres—the internal is circular, the outer is longitudinal; *b*, dilated glands; *c*, contents.

found two layers of smooth muscle fibres, both running longitudinally, and including between them a thin layer of connective tissue. In the depths the duct divides into numerous branches, and it can be here distinctly seen that the epithelial lining consists almost entirely of beaker cells.

The structure *c*, Fig. 81, consists of the same glandular forms as just described.

The gland lumina are wider than those already described, and more beaker cells are present. In the interior of this glandular structure is a substance which consists of a very delicate connective-tissue network in which are situated remarkable pyramidal cells (Fig. 84). On two sides this tissue is connected with the enveloping muscle layers, so that it is a question whether this tissue represents the secretion of this glandular structure which is undergoing organization, or whether it is to be considered as an independent myxomatous tissue form.

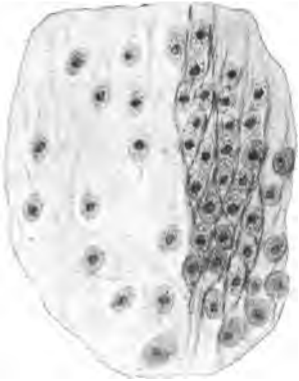

FIG. 84.—The contents *c*, Fig. 83. Cells with intercellular substance.

As is seen in Figs. 81 and 83, muscle fibres are present in all parts of this dermoid prominence, and they seem to undergo hypertrophy in the circumference of any dilating cystic structure, as may also be seen in the case of cyst *a*, Fig. 79. They are often arranged in one, two, or three layers.

At the base of the dermoid prominence is the area *b*, which is also surrounded by a muscle layer. On one side are seen the same tubules and glandular forms with beaker cells as we have observed in Fig. 82. The contents consist of a large amount of connective-tissue basis containing few pyramidal and spindle-shaped cells, and resemble myxomatous tissue.

At *k*, Fig. 81, is a glandular structure showing a lobular form and surrounded by connective tissue (Fig. 86).

In the ovarian tissue which forms the base of the prominence are dilated follicles and numerous follicles in a state of rest. The nearer we approach from the surface of the prominence to its base the less complicated are the glandular tubules, and entirely at its base is an area showing seven or eight transversely-cut ducts. Most of these are lined with a high cylindrical simple epithelium surrounded by connective-tissue fibres circularly arranged. One of these ducts has a star-shaped form, and the surface of the epithelia which line it shows a distinct membrane, but cilia cannot be found. It is probable that this duct as well as the others are remnants of the Wolffian body, and that from these, or related to these, come all the other glandular structures in this prominence.

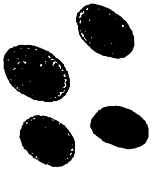

FIG. 85.

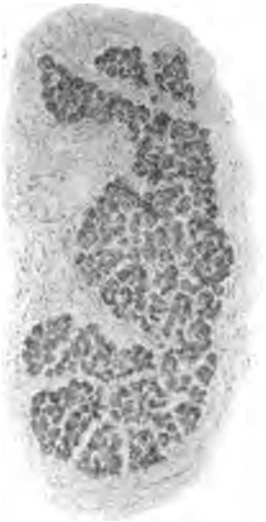

FIG. 86.

FIG. 85.—Cells of Fig. 84 strongly magnified. Cells with double contour and large nucleus lying free in the contents.

FIG. 86.—Glandular structure *k*, Fig. 81, resembling the thyroid gland, and described as such in dermoid cysts of the ovary by several authors.

The wall of the dermoid cysts at a distance from the prominence consists of ovarian tissue containing corpora lutea and Graafian follicles. The inner lining consists of simple and stratified epithelium, and is without doubt squamous epithelium.

The squamous epithelium which covers the prominence, in passing over the base takes on the form of squamous epithelium, of granulation tissue, and also of ciliated epithelium (*i*, Fig. 81).

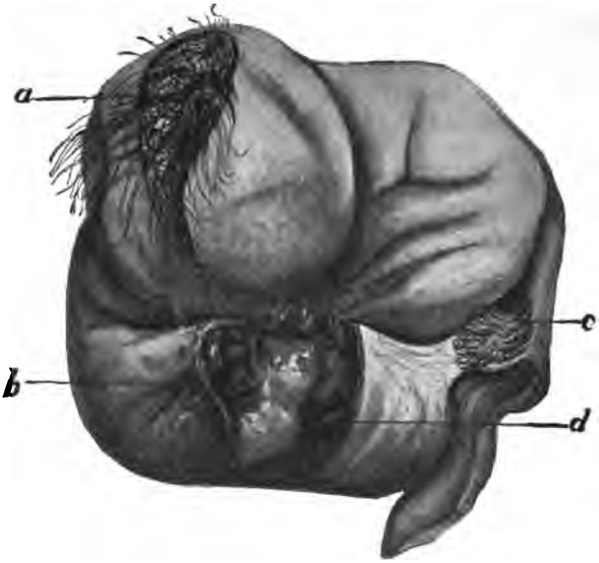

FIG. 87.—Combination tumor of Case 6, consisting of a dermoid cyst and a cystadenoma proliferum et myxomatodes. *a*, dermoid cyst; *b*, cystadenoma; *c*, tube with fimbrian end; *d*, see Fig. 92.

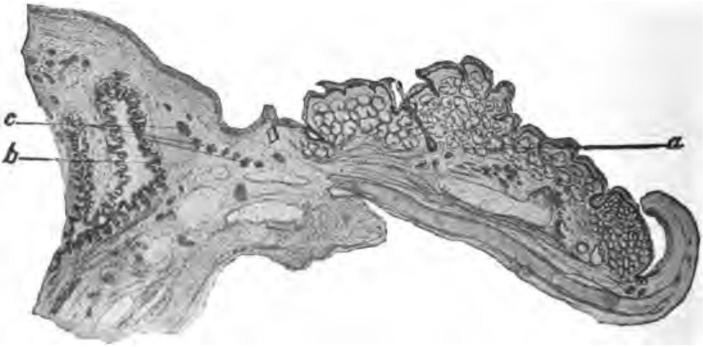

FIG. 88.—Section through the prominence (*a*) of the dermoid cyst Fig. 87, with separating wall and wall of cystadenoma (*b*). *a*, dermoid prominence; *b*, cystadenoma; *c*, separating wall with numerous vessels.

CASE VI.—One tumor is composed of a dermoid portion and a cystadenomatous portion. Fig. 88 shows a section through the dermoid prominence, and includes the dividing wall between the dermoid cyst and the cystadenoma.

The surface of the prominence is covered with squamous epithelium showing in parts a horny character. At one side the squamous epithelium passes over upon the ovarian base into the above-described granulation tissue. On the other side this change into granulation tissue takes place at some distance from the prominence. Underneath are numerous sweat glands, sebaceous glands and hairs, a small piece of bone with a pulp-like centre, and a long piece of hyaline cartilage, as well as glandular structures lined with squamous epithelium. The wall between the dermoid prominence and the ovary contains numerous blood vessels, so that this portion of the ovary corresponds to the hilus with its large vessels. In the prominence lie, further, very large cells with large nuclei and pigment granula. On one side of the prominence the squamous epithelium changes to a stratified cylindrical epithelium of a papillary character and containing numerous beaker cells.

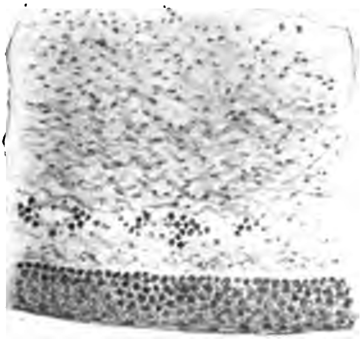

FIG. 89.

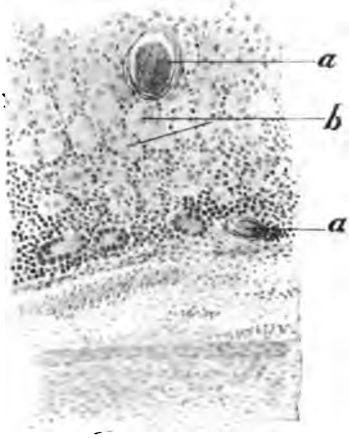

FIG. 90.

FIG. 89.—Thinnest part of the wall (lined with squamous epithelium) of the dermoid cyst *a*, Fig. 87.

FIG. 90.—Thin wall of dermoid cyst *a*, Fig. 87, showing the so-called granulation tissue with giant cells. *a*, hairs in the wall; *b*, giant cells.

The dividing wall between the dermoid cyst and the cystadenoma consists of ovarian tissue with numerous blood vessels and corpora albicantia and small cysts of the same character as the cystadenoma itself. They show distinct projections, forming an arrangement like that in the *glands of Lieberkühn,* and are lined with a high cylindrical epithelium with the nucleus at the base, and contain numerous beaker cells.

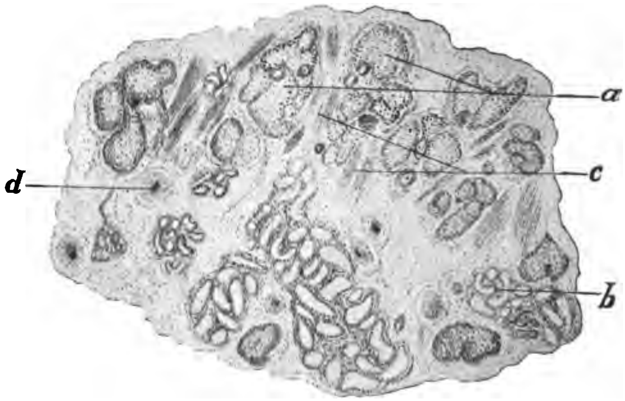

FIG. 91.—Part of the dermoid prominence (*a*, Fig. 88). *a*, sebaceous glands; *b*, sweat glands; *c*, muscle bundles; *d*, transverse sections of hairs.

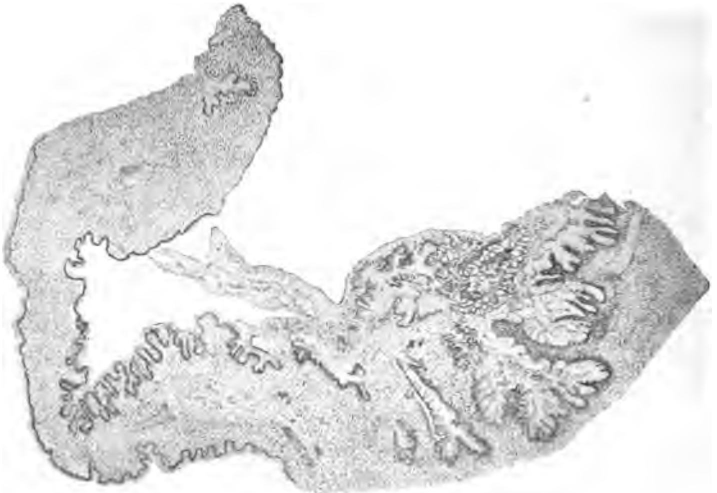

FIG. 92 —Section through thick part of wall of cystadenoma.

Fig. 89 represents a section through the thinnest part of the wall of the dermoid cyst. Fig. 90 shows hairs which have grown out of the prominence and have been surrounded by the so-called "granulation tissue" of the wall.

Near the point *a*, Fig. 88, and near the piece of cartilage, lies a spinal ganglion whose nerve fibres contain a finely granular pigment.

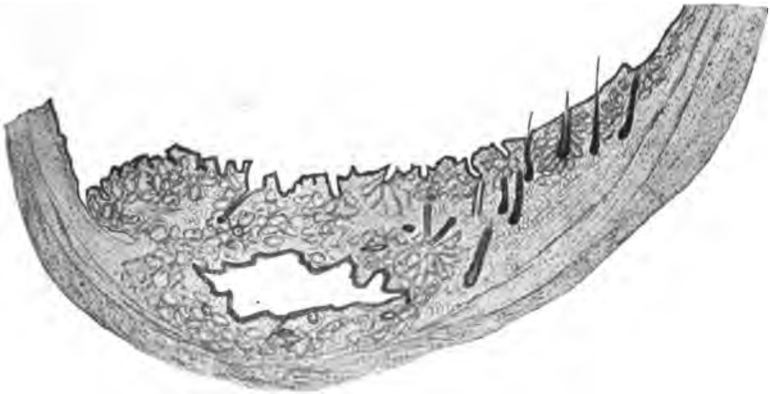

FIG. 93.—Dermoid prominence with broad base of Case 6; other ovary.

The ovary of the other side was changed into a small, thin-walled sac showing on its inner surface a dermoid prominence four centimetres long, three-quarters of a centimetre wide, and one-half of a centimetre high, forming a curve on the inner surface of the cyst, which made it impossible to include its entire length in any one section. This prominence is covered by squamous epithelium, which on one side passes over upon the ovarian base as a simple epithelium with beaker cells, and further on as a simple ciliated epithelium. The prominence

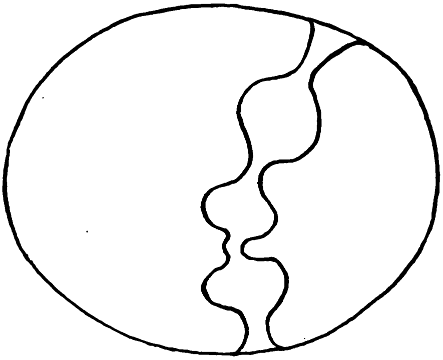

FIG. 94.—Schematic figure showing the arrangement of the three dermoid prominences in dermoid cyst Case 7.

contains scarcely anything more than sebaceous glands, sweat glands, and numerous hairs. The latter are deeply pigmented. At many points are found smaller and larger areas of pigmented cells. With the exception of fat tissue, no mesodermal structures were found.

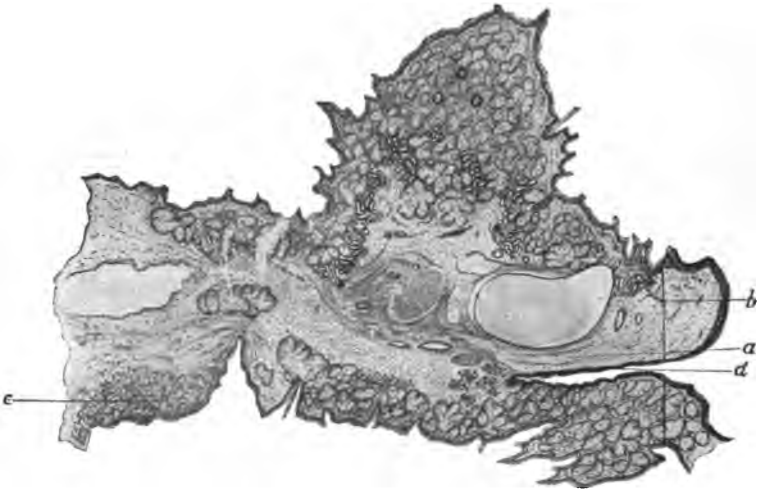

FIG. 95.—One of the three dermoid prominences of Case 7 with quill-like surface. *d*, depression of the surface lined with ciliated epithelium; *a*, glia tissue; *b*, cyst lined with cylindrical epithelium; *c*, area containing pigmented cells.

CASE VII.—Case 7 is a dermoid cyst of the right ovary and a thin-walled cyst, the size of a fist, of the left ovary.

The dermoid cyst shows on the inner surface two dermoid prominences united by a small round prominence, so that in fact three dermoid prominences are present, as is schematically shown in Fig. 94.

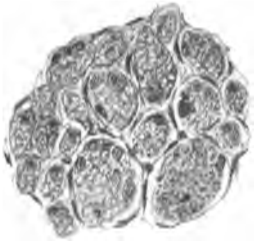

FIG. 96—Pigmented area *c*, Fig. 95, by strong magnification, showing pigmented cells with nuclei.

A section through the first dermoid prominence shows a covering of squamous epithelium with many thin projections of the surface, as may be seen in Fig. 95. They cover the prominence as if with little quills, and even in the hardened and stained specimens their length is about 6 millimetres.

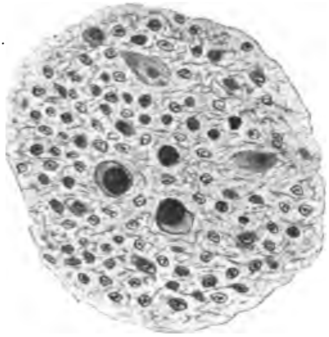

FIG. 97.—So-called glia tissue *a*, Fig. 95, strongly magnified.

Into these quills goes the connective tissue from the underlying substance, and at many points horny pearls are seen in them. It is probable that these structures form the basis for the production of nail-like or claw-like formations such as we

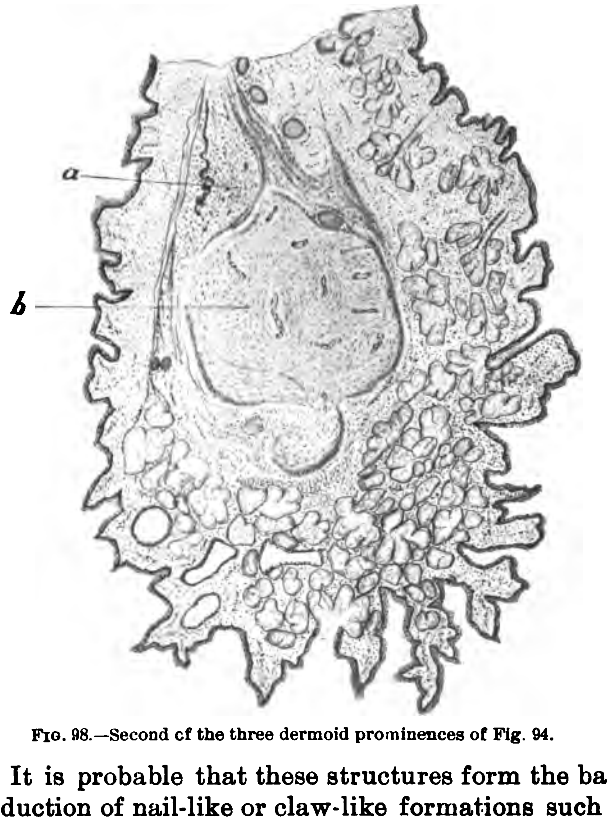

FIG. 98.—Second cf the three dermoid prominences of Fig. 94.

have seen in the specimens in the Pathological Institute in Vienna. There is further a huge growth of sebaceous glands, numerous hairs, sweat glands, fat, muscle fibres, a piece of bone with Haversian canals which in the stained specimen forms an oval 7 millimetres long and 5 millimetres wide. Around this bone, and extending up to the surface of the prominence, is a glia-like tissue (*a*, Fig. 95). It is of interest that at this point the surface is not covered with squamous epithelium, but that a depression is found (*d*) which is lined with ciliated cylindrical epithelium which sends little papillary projections into this depression. As may be observed, this glia-like tissue reaches up to the ectodermal covering of the prominence. On one side of this glia tissue lies a cyst (*b*), the size of a pea, lined with cylindrical stratified epithelium, which likewise forms papillary projections. At the base of this prominence the squamous epithelial covering goes over as squamous epithelium, while on the other side the base is covered with a pigmented tissue consisting of large cells lying closely grouped and containing small nuclei, and surrounded by small-celled tissue (*c*, Fig. 95).

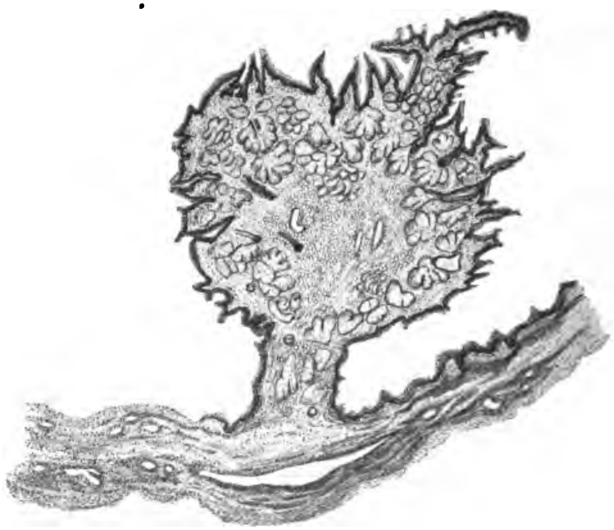

FIG. 99.—Third of the dermoid prominences of Case 7.

Under the cyst *b* lie several spinal ganglia such as were found in Fig. 88.

Because of the character of the cells pictured in Fig. 96, I believe this area *c*, Fig. 95, must also be considered as nerve tissue.

The middle of the three prominences (Fig. 98) is covered with squamous epithelium, under which are numerous sebaceous and sweat glands. In the middle is a piece of bone (*b*), of irregular form, surrounded by a fibrous capsule. Under it is also glia tissue (*a*, Fig. 98), which is a continuation of the glia tissue *a*, Fig. 95. In this glia tissue is a series of irregular, long, closely grouped cells with dark nuclei, which are also present in Fig. 95. On closer examination this area shows glandular tubules and ducts lined with a single layer of epithelium. In the glia tissue are numerous capillaries and vessels filled with blood.

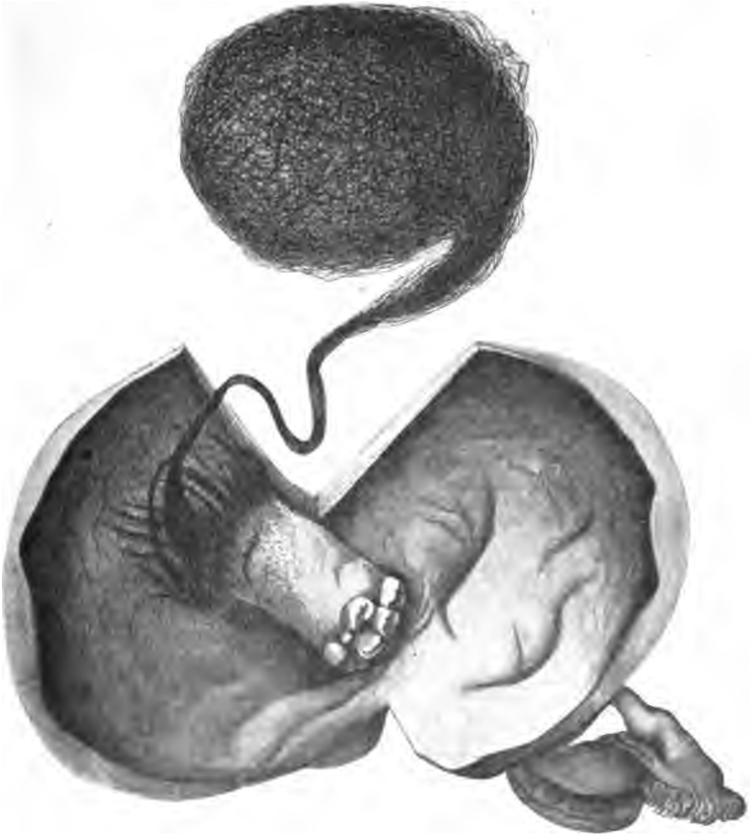

FIG. 100.—Dermoid cyst of the *left* ovary of Case 8, with a large piece of cutis-covered bone containing six *left* teeth.

The surface of the third prominence (Fig. 99) consists of quills covered with squamous epithelium, under which are very numerous sebaceous and sweat glands. The substance of the prominence consists of fibrous connective tissue, fat, and small particles of young hyaline cartilage. On the one side the squamous epithelium passes over upon the base of the prominence as squamous epithelium; on the other side it changes into the previously mentioned granulation tissue.

Case VIII.—The cyst has the size of a child's head, and was developed within the ligament, so that the ovary, as may be seen in Fig. 100, is retained as almost normal.

The contents consisted of the usual dermoid cheesy matter mixed with hair, and a large bunch of hair connected by a band of growing hairs to the cutis-like covering of the pictured piece of bone. The cutis covering of this piece of bone shows numerous dilated pores, and at its free end are eight teeth firmly fixed in alveoli. The largest portion of the interior of the cyst, as may be seen macroscopically, is lined with epidermis. A section through the ovary shows a small cystic degeneration. Part of the hilus ovarii goes over into the cyst wall. The tube with its fimbrian end was found to be almost normal.

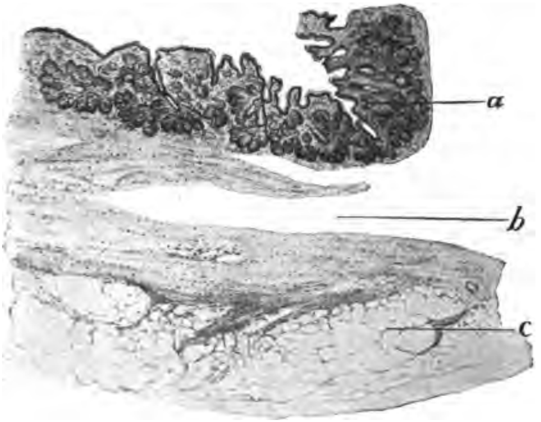

Fig. 101.—The cutis covering the teeth-containing bone of Case 8. *a*, squamous epithelium with sweat and sebaceous glands; *b*, space containing and covering the bone; *c*, fat tissue and connective tissue, being the external cyst covering of the bone.

The thinnest part of the wall consists of fibrillary connective tissue lined with a stratified so-called "granulation tissue." The thicker part of the wall consists of fibrillary and fat tissue lined within by squamous epithelium, under which are numerous sebaceous and sweat glands and also hairs. The covering of the piece of bone shows a surface of squamous epithelium, and below it a thick layer of sebaceous and sweat glands, hairs, and some islands of cartilage. The deepest layer immediately over the bone consists of fibrillary tissue with few nuclei (Fig. 101). In none of the sections of the wall of this cyst, or in the covering of the bone, was any evidence of ovarian tissue found.

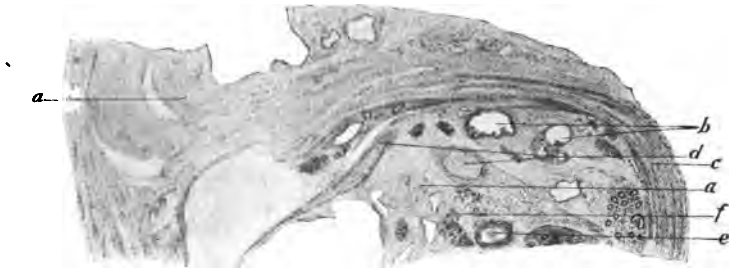

Fig. 102.—Hygroma colli cysticum. *a*, glia tissue; *b*, glands lined with beaker cells; *c*, connective tissue and muscle layer surrounding *b* glands; *d*, cartilage; *e*, bone; *f*, myxomatous tissue and striated muscle fibres.

Case IX.—This case, described as hygroma colli cysticum, contains the following products, which may be recognized in Fig. 102, and which are here described for comparison.

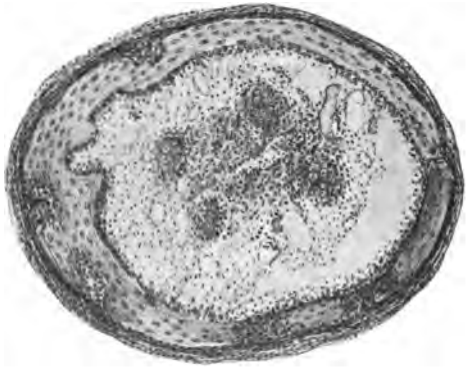

Fig. 103.—Bone *e*, Fig. 103.

The tissue *a*, Fig. 102, consists of a fibrillary or reticular basis containing numerous small round nuclei. A thorough comparison with the glia tissue seen in other specimens proves that we are dealing here with the same structure. In this tissue are found numerous smaller and larger glands or ducts

"That some cysts near which are cartilage and glands, together with the surrounding smooth muscle, and the lymph follicles lying under the mucous membrane, *again call to mind the structures of the respiratory tract, it is scarcely necessary for me to mention* [!].

"An important result of the examination, aside from this latter discovery, is the fact that this diagnosed carcinoma is a mixed tumor of the testicle which must be referred *to a three-layered formation*, since derivatives of all three germinal layers contribute in their well-known forms to its structure.

"CASE VII.—The two layers of the tunica vaginalis propria are loosely united. Since in a former examination there was an attempt to remove the albuginea from the tumor, naturally the testicle, situated at the upper end and at one side, was partially loosened also. As a proof, however, that the tumor was situated within the testicle there is found on the inner side of the loosened testicle no capsule, but the exposed testicle tubules pass over into the loose capsule of the tumor.

"Most of the spaces, corresponding to their mucous contents, are lined with mucous cells which have the well-known beaker form. Under these epithelia are found forms which show a ciliated membrane.

"Around all these cysts run, concentrically arranged, thick layers of smooth muscle fibres which often cross in layers, corresponding to the muscularis of the intestinal canal. In some cysts the inner surface is not smooth, but is covered with broad villi consisting of a loose connective tissue rich in cells, which are broader than the villi of the digestive tract, but still resemble them.

"As products of the entoderm are found *cysts lined with cylindrical cells and partly with ciliated cells, and also glands* [!]. This is the only specimen *in which the products of ectoderm are absent*, or, better, in which no products of ectoderm could be found in my sections. At any rate, the ectoderm is in all these tumors poorly developed. On the other hand, it is possible that squamous epithelial cysts may have been destroyed in a manner to be discussed later, as I found to be the case in another specimen (Case 10).

"CASE X.—In fact, it is seen in section that the albuginea covers the entire tumor and, as a result of dilatation, has become very thin.

"In this tissue, without macroscopical evidence of a connection with a normal rest of the testicle, are found three nodules the size of a small apple, which are separated by a thick capsule from the rest of the tumor showing the same structure. Aside from these three nodules showing a more varying and complicated structure, there are found three other isolated nodules of the same structure and of the size of a pea. Their structure represents a typical teratoma, and I therefore will call these nodules 'teratomata.'

"The examination of this interesting specimen strengthens the statement that the teratomata of the testicle regularly contain *products of all three germinal layers,* squamous epithelium and cylindrical epithelium, mucous membrane, embryonal connective tissue, colloid tissue, cartilage, bone, smooth and striated muscle fibres. This case seems to speak for the possibility of multiple occurrence of teratomata. The fact that in all the individual nodules, and even in the smaller ones, all three germinal layers were represented might speak for the independence of the individual tumors; on the other hand, it seems probable that through the development of the carcinoma or of the adenoma, as the diffuse tissue growth may be called, parts of the primary tumor *were detached—parts which contained cells of all three germinal layers* [! !].

"The horny pearls lying on the connective tissue cause the formation of a structure resembling granulation tissue with numerous giant cells. It seems that these giant cells *have brought, through arrosion, these horny masses to disintegration and resorption, for we find spaces which are lined with giant cells and in which only a small destroyed amount of horny pearls are present.* In Case 7 I was not able to find squamous epithelium, in spite of the fact that it was without doubt a typical teratoma. Analogous to the last described case, it is perhaps possible that in the above-mentioned manner the already existing squamous epithelial tubules of Case 7 may have been destroyed; yet I do not dare to make such a statement, since in that case *nothing pointed to such an activity on the part of the giant cells.*

"At any rate, in all our examined specimens there is no doubt that the teratomata lie with the testicle and in direct connection with it inside of the albuginea. The rule is, therefore, that the vas deferens and the epididymis take no part in the development of the tumor. In all the teratoid tumors of the testicle examined by me *the products of the external germinal layer are least developed. Fully-developed derm is never present;* the tissues of the central and peripheral nervous system *were present in no case.* The entoderm is the layer which in all these mixed tumors is most completely developed [!]. It grows, like the squamous epithelium, in the form of cylindrical-celled tubules which have a fine lumen in the centre. According to the growth and secretion of the epithelia these tubules develop into cysts. The cilia, when present, are very high and *correspond to the high cil ia of the trachea.* The epithelium of most of these spaces is a high cylindrical epithelium. The cells show partly a dark granular protoplasm and partly are typical mucous cells with smaller or larger mucous drops. In general the inner surface of the cyst is smooth, *but now and then papillary or villous formations are present* which recall the villi of the intestine. A frequent form of gland was found in several specimens; it consists of a corkscrew arrangement of the gland whereby the width is gradually increased. It is the same form which is given in the schematic drawings of the twisting tubules of the testicle, for instance, by Brösicke. I have left those pictures occurring in many cases out of consideration—namely, the occurrence of the products of the ectoderm and entoderm in one cyst—in that cysts were lined at the same time by squamous epithelium and by cylindrical epithelium.

"All these tumors contain products of all three germinal layers. In all these tumors we find undoubtedly a resemblance to the individual cell and tissue forms of a human embryo" [!!].

It may be observed that Wilms speaks of entoderm products and structures resembling those of the respiratory tract and the digestive tract, without any proof. The fact that in some cases one and the same cyst was in many instances lined with squamous epithelium and with cylindrical epithelium shows with what little justice Wilms, who is justified in calling squamous epithelium ectoderm, calls cysts lined with cylindrical or ciliated epithelium and surrounded by muscle fibres products of entoderm.

From the section "The Dermoid Cysts of the Testicle" I quote the following by Wilms:

"Verneuil found in a two-year-old child a tumor, the size of a hen's egg, in the scrotum. On section the testicle was found flattened between the tunica vaginalis and the main tumor. For this reason the tumor was called 'an extratesticular or scrotal tumor.' Verneuil considered, as a result of his observations and based on nine other cases quoted by him, that all such tumors in his opinion were peritesticular or scrotal and were malformations resulting through inclusion." Since Wilms wishes to consider this case also as having originated in the testicle, he says as follows: "If the scrotum, as in the case of Verneuil, is freely movable over this large tumor, and the testicle and epididymis externally cannot be marked off, it is probable that we are not dealing with an extratesticular or real scrotal tumor. Between the testicle and the visceral layer of the tunica vaginalis propria no tumor can develop, since the latter is only an epithelial covering of the albuginea. All these tumors lie, if they are inside of the visceral layer, also inside of the albuginea—*i.e.*, they have originated in the testicle."

Wilms says the following concerning a case of Geinitz: "This fact, that a separation from the testicle caused difficulty, proves directly that the tumor must have been in close connection with the testicle; for if the tumor, *as the author believes, had been situated in the scrotum*, a removal of it from the testicle would have been possible without difficulty."

Karning said concerning a testicular dermoid "that the tumor lay between the albuginea and the tunica vaginalis visceralis, and, for that reason, *had nothing to do with the testicle.*" In spite of this, Wilms says: "I have already shown sufficiently the impossibility of such a situation."

Böckel believed that in his case "a removal without castration would have been possible if a diagnosis had been made before operation." After castration it was found that the testicle had been pushed posteriorly and downward, and the tumor appeared embedded in the deeper layers of the scrotum.

In a case of Corneil and Berger the following was found, according to Wilms: "Since the operator desired to preserve the testicle, he dissected the cyst wall from the testicle, a process which occurred without difficulty. Only at the corpus Highmori were firm connections with the testicle present, whereby larger vessels also had to be ligated." Wilms says: "In spite of this distinct connection with the testicle, these authors still followed, in their further explanations, the old view of Verneuil in that they called the tumor 'extratesticular.'"

Wilms says further: "If we examine the statements of the authors more closely, it follows from their own statements that the tumors in the testicle originated there. They usually are connected with the *corpus Highmori.*"

In these dermoid cysts were found almost the same products as are found in dermoid cysts of the ovary, i. e., teeth, central nervous tissue, so-called "intestinal structures," etc. Wilms finds that, in contrast to the ovarian dermoids, the dermoids of the testicle are almost all congenital.

Because these tumors have been by so many authors described as extratesticular or scrotal, and because these tumors are usually connected with the corpus Highmori, and further because the following case of Wilms is a proof, we must, in opposition to Wilms, come to the conclusion, as is also evident from the quoted cases, that at least some of these dermoid cysts were found *outside of the tunica albuginea.*

Wilms examined a case which Kocher described in the following terms: "The testicle sits upon the tumor posteriorly and superiorly; its anterior surface is flattened by the tense cyst." As a result of the description and the drawing which Wilms gives, I believe that Kocher is right when he says "this dermoid developed on the anterior surface of the testicle, *between the testicle and the vaginal membrane,* in such a way that between the cutis-like mass and the parenchyma of the testicle was situated a fatty tissue corresponding to the subcutaneous tissue—a condition of importance in deciding its origin." The drawing resembles the condition found in our Fig. 62, with the difference that the testicle, which corresponds to the ovarian tissue (*a*, Fig. 62), is separated from the cyst by a connective-tissue membrane, which is absent only at that point where the dermoid prominence was situated. This membrane is a part of the cyst wall, and does not cover the testicle, but only divides it from the tumor. Wilms found in his cases of testicular teratomata that the tumor tissue was usually separated from the rest of the testicle by a connective-tissue membrane. *This membrane has been considered by other authors to be the tunica albuginea.* Since Wilms, however, found that in all his cases another membrane was present around the entire tumor, he considered this membrane, viewed by others as tunica albuginea, to be one resulting through irritation. At any rate, it must be granted that the testicular teratomata perhaps are found only in the testicle, while the dermoid cysts, on the contrary, are situated at the corpus Highmori and perhaps outside the tunica albuginea.

If we compare these conditions we find the following:

Dermoids of the Testicle.	*Teratomata of the Testicle.*
Situated at the hilus of the testicle outside the tunica albuginea, and for that reason described as "extratesticular" or "scrotal."	Situated perhaps within the tunica albuginea.
Few cysts are found in the dermoid prominence.	Contain numerous cysts of various forms. Sometimes the tumor consists of cysts only.
Ectoderm products present in large amount.	Contain little or no ectoderm products.
Contain hair, teeth, and glia tissue.	Contain no hair, no teeth, and no glia tissue. Squamous epithelium often present as the lining of cysts.

If, as Wilms believes, these tumors originate from a seminal cell, why this decided difference in their situation, in their structure, and in their arrangement?

In what way does Wilms prove that any of these cysts are entodermal products?

I deny absolutely that these cysts are derivatives of entoderm. They are surely nothing but developments from the tubules of the testicle itself or from the paradidymis, and these tumors are composed only of ectoderm and mesoderm.

The variation in the structure of these two forms, dermoid cysts and teratomata, can only be explained on the theory that these tumors are caused by displaced cells. As is known, the tubules of the Wolffian body pass from the Wolffian duct up to the celom and the later germinal epithelium. In the female they remain as paroöphoron and epoöphoron at the hilus ovarii, and in certain cases portions of these are found in the ovary. In the male, on the other hand, these tubules are present in the testicle as functionating tubules, the tubuli recti. Others form the tubuli efferentes of the epididymis, and others remain as the organ of Giraldès and as remnants, but outside of the hilus testis and near the corpus Highmori. Since the Wolffian body tubules develop from the Wolffian duct (ectodermal origin), we must believe that those parts which lie nearest to the Wolffian duct, and especially because they are regressive structures and without function, possess the elements of ectoderm most decidedly. If this be the case, it seems natural that the nearer to the hilus of the testicle (*i.e.*, not *in* the testicle) a tumor develops, the more distinctly should ectodermal products result, as the dermoids are extratesticular and the teratomata intratesticular. I believe that the fact that in testicular teratomata squamous epithelial cysts occur, as well as cysts lined with both cylindrical and squamous epithelium, speaks decidedly for the ectodermal origin of those tubules of the testis which we know to be formed from the Wolffian body. The further fact that in the dermoids of the testicle teeth and glia tissue occur (and not in the teratomata) speaks for the above-expressed explanation of the variation in the structure of these two forms of tumors, for these tissues are ectodermal (teeth only partly). Glia tissue is only a product of the ectoderm, and teeth occur only where ectoderm and mesoderm are found, since teeth are really ossified skin papillæ. How else can the absence of ectoderm products be explained in the teratomata? They develop in the testicle, and not at the hilus, and are further away from the ectodermal elements at the hilus. If our theory is not correct, and if, for some reason or other, skin and its ectoderm products are not formed in teratomata, why, in spite of this fact, is no glia tissue formed, which Wilms considers to be the central nervous system of a fetal formation? Since Wilms in the dermoids of the testicle and ovary always finds cephalic structures as the products first differentiated in the development of an ovum or seminal cell, and since in testicular dermoids bone is so frequently present, why is there found in teratomata no glia tissue, which develops decidedly independently, and quite differently than the skin? Why are there no maxillæ, why no teeth, in the testicular teratomata? His statement that certain combinations in the teratomata of the testicle represent the respiratory and digestive tracts is so absolutely voluntary that I will not criticise this statement further. When we recollect, however, how complicated is the development of the intestine, the manner in which the mesoderm develops and in which certain mesenchym cells are pushed forward to surround and form the intestinal canal and to furnish it with its muscularis, we may then understand how absolutely without foundation is a statement that glands and tubules lined with cylindrical cells and with papillary projections represent the intestinal tract, because they are surrounded by muscle fibres, and that, too, in such mixed tumors wherein the cephalic structures are supposed to predominate, in tumors which develop in an organ containing tubuli recti, rete testis, ductuli efferentes, and which in its periphery has the organ of Giraldès and embryonal remnants, of which at least the ductuli efferentes possess a wall consisting of several layers of smooth-muscle fibres. This same wall, especially under pathological conditions, may well be granted to the tubuli recti, the tubules of the organ of Giraldès, and the embryonal remnants, as is normally the case in the parovarian tubules near the ovary. Wilms is mistaken when he says that the Wolffian body furnishes the testicle only with its stroma, and that the seminal tubules in both their forms originate from the germinal epithelium.

TUMORS OF THE OVARY.—As regards the cystic structures of the ovary, we must distinguish the following forms:

1. Hydrops folliculi, without epithelium.
2. Corpus luteum cysts.
3. Cystoma serosum simplex, usually the size of a child's head and pedunculated, yet often intraligamentous; they contain a clear fluid. The inner surface is usually lined by a low, simple cylindrical epithelium. They, as a rule, show no proliferating glandular formations, but not seldom evidence papillary excrescences.
4. Cystadenoma serosum papillare, often bilateral, containing sometimes ciliated epithelium and sometimes none.
5. Cystadenoma pseudomucinosum, glandulare, or papillare.

6. Surface papilloma.

7. Grape-like cysts which are a transition form of 4 and 5.

Pfannenstiel believes that No. 3 develops from the follicles. Nagel believes such a transformation of the follicle epithelium to be impossible, for on the disappearance of the ovum the membrana granulosa is destroyed. Concerning the origin of Nos. 4 and 5, as we have shown, various authors are at variance. Among those who believe that the glandular cystadenomata develop from the primordial follicles is Steffeck, who, in a drawing of a follicle with an ovum, believed that he had shown epithelial projections in the former; but, as Wendeler says, his drawings make the impression that we are dealing with cysts or tubules lined with epithelium and that the ovum is nothing but an epithelial cell. This form of ova-like cells is shown in Fig. 85.

Flaischlen believes that he furnished proof of the origin of a cystadenoma from persisting fetal ovarian tissue. From his drawings, since this structure was found in a dermoid cyst, it is certain that he was describing the same glandular tubules as were found in dermoid cysts Figs. 77 and 82. Wendeler, in considering this tissue, calls it "thyroid gland"—an error often made by those who have described the microscopical appearance of ovarian dermoid cysts.

Pfannenstiel believes that the adenomatous neoplasms have been proved by him and by others to originate from the covering epithelium of the ovary and from the epithelium of the follicle, but he does not consider all these proofs as positive. He shows a drawing in which cysts lined with ciliated epithelium have been formed from the surface epithelium. However, he has not shown that these cysts have not opened upon the surface instead of having originated from the surface. He believes that the pseudomucin cystomata originate from the follicle epithelium, and he shows drawings which are supposed to represent the transition of a follicle into a pseudomucin cyst. His drawings contain also those ova-like cells. A comparison with our drawing, Fig. 83, shows that we are dealing with no follicle and no ova, but with cysts which contain the same large cells with distinct nuclei as we have illustrated in Fig. 85.

As yet, therefore, no one has shown the transition from follicles to cystadenomata. Concerning the possibility of the origin of the latter from the epoöphoron, Pfannenstiel says that such a view, from the theoretical standpoint, does not seem impossible, but is improbable because epoöphoron tubules do not occur in ovarian tissue. This latter statement is incorrect, for the presence of these tubules in the ovary itself has been proved in many cases. He considers the pseudomucin cystomata as originating from the follicle epithelium, and the serous cystadenomata as originating from the ovarian germinal epithelium, and says: "When we consider the fundamental difference between an epithelial cell of a pseudomucin cystoma and a ciliated cell of a serous cystadenoma, and when we consider that these two tumor forms are almost never united in one tumor, it seems to us incorrect to transfer conditions which concern the one group to the other." This is a view which cannot be defended, for a pseudomucin cell is only another form of a ciliated cell, and it is still more strange to consider a pseudomucin cell as originating from follicle epithelium. In many sections of Cases 2 and 5 (Case 2 was described for this reason) we see how ciliated epithelium gradually goes over into a high epithelium with membrane, but without cilia, and how this epithelium at other points contains beaker cells. In Fig. 63 we find in cysts *a* and *b* stratified ciliated epithelium and stratified epithelium with excrescences. In Case 2 we find in the ovarian cysts ciliated epithelium, and in the intraligamentous cyst *e* ciliated epithelium with projections, and papillary excrescences which are covered with ciliated epithelium and with epithelia containing beaker cells. In Fig. 70 we find cylindrical epithelium, ciliated epithelium, and epithelium with beaker cells going over into each other, and yet the underlying ducts and tubules are without cilia. In Fig. 79 the inner lining of the dermoid cyst shows a ciliated epithelium, and yet derived from it are glandular structures lined with cylindrical and ciliated epithelium and the cyst *a* whose epithelium shows cilia and excrescences. Whether the smaller cysts are derived from this surface ciliated epithelium, or whether the surface ciliated epithelium is derived from the little cysts which open upon the surface, cannot be decided; at any rate, the connection between the two is certain. In Figs. 77, 82, etc., we have epithelia which in Fig. 92 show the transition from cylindrical epithelium to epithelium containing beaker cells.

If, therefore, we compare the various forms of cysts of the ovary and the glandular structures which are found in dermoid cysts of the ovary, on the one hand, with the cysts of the testicle and of the testicular Wolffian body remnants, and the glandular structures which are found in teratomata and dermoid cysts of the testicle, on the other hand, we must say that the origin of both is the same. Since the cystadenomata of the testicle can develop only from the Wolffian tubules, whether the latter are tubuli recti, rete testis, or the organ of Giraldès or Wolffian remnants, we must, at any rate, accept the same mode of origin for the cystadenomata of the ovary. In Case 2 we have in the ovary and in the intraligamentous cyst *e* the same lining, so far as ciliated epithelium is concerned. Since in the cyst *e* are found also epithelia with beaker cells and also tubules of the form *of the glands of Lieberkühn,* the same epithelia may also occur in the ovary, as is the case in the pseudomucin cystomata. Since the intraligamentous cyst *e*, Fig. 66, is without doubt a parovarian product, we can with justice say that the same tubules are the cause of the ciliated cysts in the ovary (*a*, Fig. 66).

Nagel says:

> "Von Recklinghausen has recently adopted the view that the cystomata of the ovary originate from rests of the Wolffian body, and I believe that he is right. For the ciliated cystomata such an opinion has already been given, in that they are considered to originate from the parovarium. The tubules of the epoöphoron sometimes extend far into the hilus of the ovary, and the epithelium of the epoöphoron is not always and everywhere covered with cilia, so that not every cystoma originating from these tubules must be a ciliated one. In the remnants of the Wolffian body we have a heterogeneous structure consisting of epithelial tubules, from which, as Von Recklinghausen's investigations have in no slight degree proven, cystic tumors may develop. The origin from Wolffian body tubules also clearly explains the fact that the ovarian tissue, as a rule, disappears even in the smaller cystomata, for a neoplasm entering from the hilus extends in all directions, and at the same time involves the ovarian tissue, while a growth beginning at any point of the surface does not so involve the ovary. This view of Von Recklinghausen, as to the origin of cystomata from the epoöphoron, has been considered in my division, in that, following the suggestion of Corneil, the erroneous term 'adenoma' has been entirely omitted, and *the papillary and ciliated cystomata have not been considered as special tumors, but only as forms of the cystomata.*"

Concerning papilloma ovarii Nagel says:

> "Some consider the surface papillomata to be penetrating papillary cystomata; others consider that they develop on the surface of the ovary through growth of the ovarian epithe-

a germinal or fetal formation attempts to develop. Through the mechanical disturbances in the way of growth in the small cysts, only the tissues which are first differentiated come to development in this fetal formation, and *the rest are destroyed in their beginning by the first.* With this easily understood statement an explanation is rendered concerning the peculiar structure of the prominence and concerning the fact that ectoderm predominates while the entoderm shows only small rudiments."

I do not find such an explanation to be easily understood. It does not explain the difference in structure between dermoids and teratomata, and, besides, the teratomata of the testicle consist almost exclusively of so-called "entoderm" and very little ectoderm is present there. It is a peculiar theory that the tissues which are first differentiated have the power, after they destroy the other cells, to continue their growth. Wilms considers that the cephalic tissues are those which are first differentiated, because he finds teeth, so-called "brain tissue," maxillæ, etc. These, however, *are not cephalic structures, for teeth occur in dermoid cysts in almost all parts of the body*—for instance, in dermoids of the hypophysis, in dermoids of the mediastinum, in such behind the kidney, etc. The glia tissue of the nervous system, which is to be considered only a product of ectoderm, has been found in the various cases quoted by us, in the retroperitoneal dermoid of Marchand, in the cervix teratoma of Geyl, and very plentifully in Case 9. In the cases of Marchand and Geyl there was surely no connection between this nerve tissue and any neighboring normal nerve structures. The bones in dermoids grow irregularly and can take on all possible forms, and, since in them teeth are not infrequently found, it is no wonder that they have often been called "maxillæ." We find in Fig. 100 a bone showing on its inner end eight firmly seated teeth, second teeth. To answer all questions concerning their origin, only the following must be taken into consideration: In this cyst the bone grew so that it was covered on all sides by ectoderm of the character of the skin. Hereby, through the presence of ectoderm and mesoderm, the formation of teeth resulted, just as normally the teeth in the mouth are the products of the presence of ectoderm and mesoderm, and the same process may occur in any dermoid cyst.

Wilms says:

"Through a decided pressure within the cysts the displacement of the organs of the embryom is a more decided one and

> the dermoid prominence is absent. Yet all three germinal layers are in evidence. In some cases the anterior region of the embryom predominates or is prominent—*i.e.*, the mouth in which the development of teeth has occurred. Everything else lies compressed in the cyst wall. If the cyst wall is not elastic, there result very rudimentary forms. If the cyst in which the germinal formation develops can be dilated, and if the embryom has the opportunity to become further differentiated and to bring the various organs to more complete development, then the cranial bones can develop to the formation of a complete cranium, large maxillæ with rows of teeth occur, as also thyroid gland, *salivary glands*, trachea, intestine, eye, brain in enormous extent, extremities, etc. In all specimens the central nervous system can be found, because those organs which are formed early are present, as a rule, in ovarian embryomata."

We see what hypotheses Wilms brings forward to explain the origin of the various complicated cysts. An ovum is capable of normally dilating the uterus; it grows in the tube until it bursts through the wall, or it may continue its growth in the abdominal cavity, but in the ovary it cannot dilate the cyst wall but lies compressed in it.

I believe that the retroperitoneal case of Marchand disproves the statement of Wilms to the effect that "the development of solid ovarian 'embryomata' (teratoma) occurs only in the ovary and not at other points of the body."

Wilms says:

> "These teratomata take their origin from a sexual cell, but the embryonal tissue grows without limit, and in this limitless growth lies the characteristic difference between them and the cystic dermoids. Characteristic is also the formation of entire organs of an embryo; at various points normal tracheal tissues are produced. If around mucous cysts with villous formations there is grouped a single or double layer of smooth muscle fibres, and if under the epithelium of the cysts are found lymph follicles, and even entire Peyer's patches, then the resemblance to a rudimentary intestinal formation is not to be mistaken."

We have already shown that these "intestine-like formations" are products of ectoderm or of the Wolffian body, and that in every way they show the character of a simple cystoma mucinosum of the ovary and are nothing else than salivary-like structures. As regards the tracheal tissues, these are areas in which, near cysts lined with stratified cylindrical or ciliated epithelium and never the so-called "mucous cysts," cartilage is present—areas which we have shown in several of our own specimens (see Fig. 64), and which are also present in Case 9 and in numerous ovarian and other dermoids. Weigert described these intestine-like structures in his "teratoma orbitæ congenitum," Marchand in Figs. 8 and 9, etc. Weigert also described "bronchial elements" in his case.

As we shall state later, exactly the same tissue combinations have been described by some in dermoid cysts of the ovary as intestinal structures, and by others, because cartilage was present, as trachea, and by others as the nasal tract. We have already seen that muscle fibres are often present in profusion in the dermoid prominences, and how they have a tendency to be grouped in one or two layers about cystic or dilating structures. In spite of this Wilms says:

> "Smooth-muscle fibres are grouped in distinct layers around the cysts and ducts lined with epithelium and belonging to the respiratory and digestive tracts, and especially about the intestine they are arranged in a double layer like the normal muscularis. Striated muscle seems to be seldom present. The internal germinal layer is not so well developed as the external layer. Through mucous glands and islands of cartilage lying near ciliated ducts, and through numerous layers of smooth-muscle fibres, the pictures correspond in the minutest details to the trachea."

Wilms believes that he finds centres of this region in all specimens. He says:

> "The organs of the digestive tract are rare. Smaller intestine-like tubules, ducts, and cysts with mucous or cylindrical epithelium, with a basal membrane and beaker cells, with lymph follicles in the mucous membrane, with a loose submucosa and a muscularis, I have found very often. Larger and macroscopically recognizable intestine with mesentery have been rarely observed [but not by Wilms]. Liver, kidney, etc., have not been found. Von Recklinghausen found in one cyst *a structure resembling in its entire form the fetal genital gland—namely, the Wolffian organ.* Several exact observations of extremities exist, and fingers with joints, joint-like unions of bone, ribs, etc., have been found. Thyroid-gland formations have also been described. I have seen three times relatively extensive thyroid formations which differ in no way from the usual thyroid gland. In one case I found a lung formation. The above-quoted discovery of a rib proves that thoracic parts may be found."

Wilms believes that all this proves that "the ovarian embryom is able to reproduce, even to the minutest detail, the structure and character of normal organs. Rudimentary development of eyes has been frequently observed; the most complete observation is by Baumgarten." In order to show upon what groundless foundation this hypothesis is supported, it is necessary to read the descriptions of the various reported cases in which it was considered that cranium, thyroid gland, mamma, nose, trachea, intestine, etc., were present. The exact description of these cases shows that they contain the same tissue groups as in the quoted cases of Rindfleisch, Weigert, and Marchand—*i.e.*, dermoids or teratomata of hypophysis duct, of the eye, and of the kidney region. All these were described as fetus in fetu.

Since Wilms says that Von Recklinghausen "found in a cyst a structure resembling in its entire form the fetal genital gland—namely, the Wolffian organ," I quote the following from the description of that case. It is certain that this discovery speaks for our theory of the origin of ovarian dermoids.

> "In section there was found:
>
> "1. On the surface a one-half-millimetre-thick cutis with hair follicles.
>
> "2. Beneath it fat tissue.
>
> "3. Within it islands of cartilage and cysts (*a*) with cylindrical epithelium, (*b*) dermato-cysts.
>
> "4. Deeper down, bone either as projections or as plates. In the other section—namely, that connected with the cyst wall—the nodules are solid and consist of a soft white tissue. Closely grouped but epithelially arranged cells and strands forming a built-up network lie in a connective-tissue stroma, so that the entire structure resembles a fetal genital-gland formation—namely, the Wolffian body."

I must mention here that Wilms found in one dermoid prominence a thick blood vessel dividing into a branch leading to the mouth (carotis interna) (!) and an artery leading to the brain (carotis externa) (!), and that in the description of his cases he follows closely the course of the so-called "brain" with lateral ventricles, central canal, etc. (??).

I quote the following case by Wilms, which he puts at the head of his description "because it is a real, perfect example" of his views concerning the character of ovarian dermoids. He says: "The relations are seldom seen so simply and so clearly."

> "*Cysts with Simple Prominence containing Scalp, Cranial Bones, Brain, and Intestinal Canal.*—The larger cystic portion of the tumor consists of two spaces, of which the one is a simple ovarian cyst, while the other is filled with hair and

sebum and proves to be a dermoid cyst. The thin, almost translucent wall of the dermoid cyst is covered with a thin layer of epidermis which consists only of cells of the rete Malpighi and of a delicate stratum corneum. Near the ovary there projects into the lumen of the cysts a thick prominence covered with cutis and hair."

"The internal structure of the prominence is easily recognized (in Fig. 105). The drawing, which shows the natural relations enlarged four times, shows how from the connective-tissue capsule a projection passes off which becomes smaller toward the end. Surrounded by skin, it presents only at its point a small opening, the excretory duct of a tube to be later described. The skin (*a*) on the surface is well developed and filled with numerous large sebaceous glands and sweat glands. Near the large sebaceous glands are a few hairs which penetrate into the subcutaneous fat tissue (*c*). The connective tissue of the skin is very firm. Smooth-muscle fibres are here present in small amounts. The epidermis shows all the normal layers. The skin on the under surface of the prominence (*b*) is not so well developed and shows only few glands and hairs. The subcutaneous fat tissue, which on the upper surface is well developed, is here entirely absent. The entire skin envelops a flattened tube of elastic connective tissue (*d*), which also is most completely developed on the upper surface. Toward the point of the prominence the tube is not closed, but extends quite up to the skin. At the opposite end the elastic tissue passes over gradually into the connective tissue of the cyst wall without sharp demarcation. In the midst of this elastic covering, which, as said, lies under the thick cutis, is found a four-millimetre-long, flat, marrowless bone (*e*) which, presenting few Haversian canals, shows a distinct lamellar arrangement. The connective tissue near the bone is richer in cells, but a distinct layer of osteoblasts, which prove an existing growth, is not present.

"In order to make the description of the skin and the underlying elastic tube more clear, I will now call attention to the fact *that we must consider the skin as the scalp and the elastic tissue as cranium with a rudimentary cranial bone* [??]. *This view is absolute if we examine more closely the contents of this elastic tube.* It is filled with a flat cerebral substance (*f*), 1.5 centimetres long and 2 millimetres thick, and forming the main element of the prominence. A division into white and gray substance *is impossible even with the aid of Weigert's stain.* In spite of careful hardening, only here and there areas are stained after Weigert. Since this would lead me too far into details, *I will not go closely into the description of the various forms of ganglion cells.* The glia tissue is richly developed in comparison with the specific nervous tissues, and seems, through its strong growth and because of the lack of space, *to have prevented the development of nerve fibres and nerve cells.* About in the middle of this brain mass and parallel to the long axis of the prominence is a canal lined with cylindrical epithelium (*g*) which corresponds entirely to the central canal—*i.e.*, to the brain ventricles. The vessels of the brain are well developed and run in their main branches (*h*) parallel to the long axis of the prominence. The areas of the elastic capsule lying directly on the brain mass show a wavy structure *and seem to represent the dura mater.* A noticeable condition in the brain is presented by groups of corpora amyloidea (*i*). Most of these have a more or less distinct concentric arrangement and are like the same structures occurring in senile brains. Since these structures occur so frequently in the other cysts, I must mention here what is necessary concerning them.

"I find in the literature only scattered references concerning the occurrence of such amyloid like structures. This is strange, for it is in contrast to my own experience, for I found such bodies present in all my specimens of dermoid cysts of the ovary. I mention that they were for me of great value in the beginning of my examinations, as they called my attention to the central nervous system through their noticeable form, easy of recognition. As may be seen above, *the appearance of such a brain is microscopically different from that of the normal central nervous system through the strong development of the glia fibres.* Without going further into the still unexplained origin of these amyloid bodies, I will only mention that their regular occurrence in dermoid cysts under such disturbances of growth and mechanical injuries (through preparation for examination) speaks for their origin from expressed myelin.

"The nerve substance of the brain, as may be seen in the drawing, becomes thinner and smaller toward the point of the prominence. The extreme end is covered on the upper surface by the elastic membrane of the dura, while on the under surface the elastic membrane ends at some distance from the point of the prominence. I leave it unsettled *whether we may make here a comparison with the exit of the nervus opticus* [??]. At its anterior end the brain substance dilates again and surrounds a space lined with cubical epithelium (*k*). Into this space projects a mixture of prominences *which resemble closely the villi of the plexus choroideus* [??]. These structures consist of vessels which are covered externally by a layer of cubical cells. The lumen of this anterior space, *perhaps to be compared with the lateral ventricles,* does not stand connected with the lumen of the already-mentioned central canal, but shows a connection through a band rich in cells which seems to be the continuation of the compressed central canal.

"Under the anterior part of the nervous layer at the point of the prominence is a canal (*e*), one centimetre long, showing a distinct layer of high ciliated epithelia. The latter have very high cilia and resemble absolutely the epithelial cells which occur normally in the respiratory tract. The lumen of the canal is dilated, the wall is slightly folded. The canal opens at the point of the prominence as a fine canal, where its ciliated epithelium is sharply demarcated from the squamous epithelium of the covering skin. The immediate surroundings of this canal, *which is to be considered as the intestinal canal,* is formed by smooth-muscle fibres and elastic connective tissue.

"The description of the prominence being completed, we will attempt to make clear its resemblance to a rudimentary fetal formation. When we consider the first formation and the further differentiation of the three germinal layers, we observe at once the resemblance of the described prominence to those formations at certain stages. We come to the conclusion that the development of the medullary furrow into the medullary canal has taken place. Within it the central nerve substance, as an ectodermal derivative, has come *to decided development.* Under the brain, which is enclosed by the dural sac, the pericranium and a cranial bone have been developed. The skin above it, *which resembles fully the scalp,* is well covered with hair on the upper surface and has *followed well the normal forms.* The mesoderm, in contrast to ectoderm, is less developed. *The only entodermal formation to be found* is the small canal lined with ciliated epithelium. *It represents the combined formation of the respiratory and digestive tracts in the most rudimentary forms* [??]. How far the normal condition, in minute details, has been imitated I cannot follow further. My duty is limited to proving, if I may say so, *the macroscopical resemblance of the dermoid prominences to embryonal formations.*"

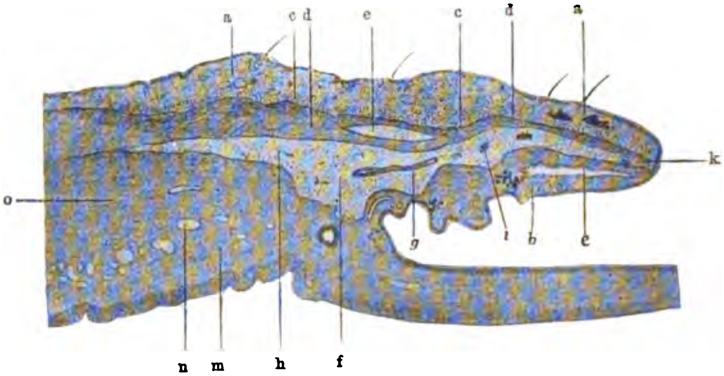

FIG. 105.

When we consider this "perfect example," we find really a prominence covered with squamous epithelium which on one side passes over the base upon the ovarian substance. In this prominence we find sweat glands, sebaceous glands, connective tissue, a piece of bone, a canal (*g*) lined with cylindrical epithelium, and a depression of the surface (*e*) lined with a high ciliated epithelium. This depression (*e*) Wilms calls "entoderm," supposedly representing the combined formation of the respiratory and digestive tracts "in a most rudimentary form." It is certainly interesting to observe from this one case with what ease such a hypothesis can be formed. It is difficult to understand with what right the canal *e* is called "entoderm." It is in fact only a depression of the squamous epithelium of the surface with a change into ciliated epithelium, as has been shown in Figs. 70, 71, 95 (*d*), etc. This ciliated epithelium is of ectodermal origin and is found in many of the cysts, and is normally present in the Wolffian body, in the Fallopian tube and in the uterus, in the nose, etc. —all areas derived from ectoderm. That in the glia tissue (*f*) a canal lined with cylindrical epithelium is present is very natural, for these glandular structures, found in all parts of the dermoid prominences, are nothing but ectodermal products, as is also the glia tissue. It is certainly taking much for granted to consider the piece of bone *e* a cranial bone, and to consider as the development of an embryom what in reality is only a mixed tumor resulting from displaced cells.

Wilms says that "trachea has been described by Baumgarten, nose by Böttlin, intestine by Perls, Neumann, and Baumgarten, structures resembling the eye by Baumgarten, mamma by Velits, extremities by Klausner, central nervous system by Friedreich, ribs and pelvic bones by Küster," etc. If we compare these various descriptions with Fig. 22 and with the microscopical description of the cases of Breslau, Beck, Weigert, Marchand, Kümmel, etc., we find in all of them the same structures, absolutely alike in every way. Since the dermoid cysts of the ovary result from displaced cells, it should be expected that in these and other dermoid cysts ectodermal and mesodermal cells should form the same structures. Entodermal products are nowhere present in our specimens. In the quoted cases of dermoid cysts in other parts of the body errors have been made in the macroscopical determination of the tissues present and also in the microscopical value attached thereto. In the above-mentioned cases exactly the same errors in the description of the same tissues may be observed.[1]

Wilms found a dermoid cyst in the ligamentum latum which had nothing to do with the ovary. "With the inversion dermoids formed in the development of the Wolffian duct this cyst has nothing to do, for it is no pure cutis cyst. The question to be answered is, Where does this tumor originate?" Since Wilms considers it possible that the Wolffian duct is in a position to carry ectoderm cells into the ligamentum latum and to cause pure cutis cysts, and yet because this cyst contains more than ectodermal structures, and, for him at least, only an ovum can cause a cyst containing products of three germinal layers, he finds it necessary in this case to discover ovarian tissue. Although he grants that the case of Marchand (behind the kidney) is caused by the Wolffian duct and the cells displaced by it (and this tumor is certainly more than a cutis cyst), and although he explains the mixed tumors of the cervix and the vagina as caused by a displacement of mesoderm cells by the Wolffian duct, he seems to overlook the possibility of a displacement of ectoderm and mesoderm cells into the hilus of the ovary. He says concerning this case: "The microscopical examination of the apparently connective-tissue prominence in the cyst wall gave surprising results. In this prominence was found within a very cellular stroma a series of small corpora fibrosa *corresponding entirely to those of the ovary.* Primitive ova were not present. With this explanation—namely, that this tumor developed from a third ovary—the danger which seemed to threaten my work was overcome. I leave untouched, since it is not a part of my work, the question as to how this third ovary, without any connection with the other, came into the anterior side of the ligamentum latum, and especially in connection with the ligamentum rotundum." The presence of a "third ovary," although rare, cannot be denied in certain cases. In this case, however, without seeing an illustration of the ovarian tissue in the wall of this cyst with its "corpora fibrosa" corresponding to those of the ovary, the presence of a third ovary cannot be granted.

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[1] See Archiv. für Gynäkologie, Bd. lxi.

Wilms finds it necessary naturally, in explaining such cases, to always think of ovarian tissue. He says: "The already mentioned possibility of a displacement of epidermoid tissues in the formation of the Wolffian duct I have already considered to be inappropriate in the case of dermoid cysts of the ovary. I must mention that I was not able, on such a theory, to explain most of the cysts of the ovary. It is evident that, in the development of the Wolffian duct, only cells from the dorsal side of the embryo could be displaced, and that, therefore, only pure cutis cysts could result [?]. Then it would remain as inexplicable as before where teeth, eyes, and the various other tissues in these cysts could originate. A displacement from those portions of the body in which these prevailing tissues of dermoid cysts normally occur—*i.e.*, the head and neck—has also been brought into consideration with the necessary reserve." That Wilms comes to these conclusions from erroneous premises may be seen from the following facts: 1. The pronephros and the Wolffian body originate at a point which corresponds to the subsequent situation of the kidney and the heart. 2. It is beyond question that the Wolffian duct and the Wolffian body can displace mesodermal as well as ectodermal cells. 3. We find in dermoid cysts of the ovary only ectoderm and mesoderm products. *Entoderm is never present.* 4. Teeth are found in dermoids in so many parts of the body that their presence is no evidence of the existence of cephalic structures, and they have no specific significance. 5. The so-called "eye structures" have nothing to do with a real eye formation. 6. Glia tissue is only an ectodermal product, and is, therefore, no evidence of the presence of cephalic tissues.

In one case Wilms describes the following:

> "In the connective tissue of the gland near the brain are seen black, very fine pigment masses arranged in a series and forming a union of the brain with a large space within the gland. This space is filled with a congealed substance and is lined by a dark, granular, cubical epithelium which is quite different from the epithelium of the other glands. In its lumen are two nodules with a thin pedicle, of which the one shows dark, granulated, epithelial cells, while the other is thickly covered with a fine black pigment. From the first these masses remind one of the pigment layer of the retina, and I believe, although under the abnormal conditions of growth nothing further resulted which resembles an eye formation, *that I am justified in calling both nodules rudimentary eye formations.*"

In another case Wilms says:

> "These thick bundles of nerve fibres run toward the dark spot evident in the drawing, and then divide in various directions. This dark spot, which lies directly on the brain, consists microscopically of brown-black pigment, as is found in the retina. The same pigment lies also within the brain and in the neighborhood of the dark spot. *Although I was un-*

> *able to find any other structures which could belong to the retina*, I believe that this pigment deposit must be brought into relation with an attempt at forming an eye."

I believe that this description, as well as the case of Baumgarten, wherein not alone one, but numerous cysts lined with pigment epithelium were present, as well as the fact that Rippmann described the pigment epithelium of the eye in a tumor in the cranium, and the fact that Kümmel in his case also found pigment cells, excludes the possibility of attaching any specific value to these structures and that they are no evidence of the presence of cephalic tissues.

7. The predominating tissues, although the displaced cells come from the upper part of the body as a result of the situation of the Wolffian body, have nothing to do with the normal tissues of the head and neck. 8. Exactly the same tissues, exactly the same glandular structures, have been described in the various dermoids in the other parts of the body—cases beyond doubt due to displaced cells. 9. Mesodermal tumors without ectoderm also occur in the ovary. Reis described an enchondroma ovarii in which were present hyaline cartilage, bone, and a series of cysts which were not closely described. Wilms says: "I consider the name 'chondrom' the best for such cartilaginous tumors which occur in different organs, and which *have nothing in common with our complicated tumors.*" Wilms, in the case of the testicle, is quite willing to classify such tumors as teratomata. This tumor of Reis has, however, something in common with dermoid cysts, in so far as both have originated from displaced cells. The difference is that in the former no ectoderm cells were removed.

Wilms says:

> "The view that all complicated tumors of the ovary must be congenital seems, in my opinion, to be incorrect. We know that the dermoid cysts of the ovary are rarely found in their beginning stages. Further, we can observe that the growth of the cysts is a very rapid one, when once the stimulus thereto has been given, so that usually within a year after the beginning of the first symptoms operation is necessary. We must therefore believe that in those 70-year-old patients the development of the malformation began one or two years, or at least only a few years, before. Where, however, the germ therefor rested until then, concerning this we can furnish no proof nor form any opinion. If we accept, as is generally done, a long-slumbering formation, which through some unknown irritation is stimulated to growth, it only makes the

relations more complicated and still more inexplicable. Why in one case such an irritation and such a growth should develop in a child and in another case at the senile period remains as dark as before."

Since Wilms does not consider all the dermoid cysts to be congenital, he sometimes finds an explanation for the presence of teeth difficult, and accepts for this the following interesting hypothesis: "If the dermoid cysts are considered as rudimentary embryos, we should expect in them milk teeth corresponding to the normal. Since, however, the statements concerning milk teeth in dermoid cysts are very rare and uncertain, we are forced to adopt the theory of *a certain dependence, as regards the development of organs within the dermoid cyst, upon the age of the mother.* We must believe that, under the influence of a common circulation of the maternal and fetal organisms, tissues like the teeth follow in their development the form and structure of those of the mother."

We are therefore, according to Wilms, compelled to believe that an ovum develops without fecundation, but is so influenced by the maternal organism during its development that in a tumor which, according to Wilms, may be only one or two years old, second teeth are formed because the mother has second teeth. It is not to be questioned that the occurrence of second teeth certainly speaks for our theory as to the origin of the dermoid cysts of the ovary. Such an explanation as the above one given by Wilms is certainly a startling innovation. To my mind it is an indirect proof of the fact that the cells which form these second teeth are independent structures and certainly as old as the other cells in the body of the patient.

Wilms stands opposed to our pathological views in discussing the carcinomatous degeneration of dermoid cysts. He found in the literature eight cases in which it was positively proven that the cutis of the dermoid cyst itself was the seat of origin of the carcinoma. To these eight cases is added a ninth of Wilms. He says:

"In recalling the meaning of such observations for the theory of Cohnheim I would mention the following. At the present time we may consider as an active factor in the origin of carcinomata the condition wherein the foreign substances within the dermoid cysts exert a constant irritation which leads to growth of the cutis. We have recognized the dermoid cyst as an embryonal malformation which grows so rapidly that already within a year or two after it has caused symptoms it must be removed from the body. We have before us, then, the peculiar fact that in an organism one or two years old the development of a carcinoma takes place. This process, *which directly opposes our present views concerning carcinoma and its development,* compels us to believe in a certain *dependence of the ovarian malformation upon the maternal organism."*

I agree with Wilms as regards this dependence, but this dependence dates back to the embryonal period of the carrier of the dermoid cyst; and since this cyst is the end result of displaced cells, these cells and their products are subject to the same changes as the normally-situated tissues, and if they undergo carcinomatous degeneration then these displaced cells and their products follow the law of Cohnheim.

As regards the so-called "brain tissue," Wilms finds that it occurs in varying amounts in the various cysts.

> "Its encapsulation in connective tissue and a very elastic capsule is the usual form. From this capsule there enter into the substance of the brain septa with blood vessels which imitate the formation of gyri and sulci. *A differentiation into gray and white matter or the presence of central ganglia is in nowise fully evident;* only occasionally do we recognize in a cellular zone which runs parallel to the surface of the brain *an attempt at a division into cortex and medullary substance* [?]. I have already called attention to the fact that *only remnants of the nervous elements are present,* while, on the other hand, *glia tissue is very well developed."*

It is naturally impossible to attach any specific value to such conditions or to say that cephalic tissues are present. Such a statement loses its value, for, practically speaking, only glia tissue is present, and this in the dermoid prominence is only a product of the ectoderm, just as is the cutis. The statement that this tissue represents the brain of an embryo is quite as voluntary as the statement that the cutis *a,* Fig. 105, is the scalp, for in all dermoid cysts, in whatever part of the body they may be found, the same skin-like areas covered with long hairs have been found.

> "As regards the formation of the digestive tract," says Wilms, "the simplest evidences are furnished by cysts and ducts *which are lined with cylindrical cells.* At times the latter are furnished with a basal membrane, and between them are found typical intestinal beaker cells. Aside from the few cases in the literature, such areas have been found in four of my cases. The resemblance of such cell formations and of the entire picture to the intestinal mucous membrane is made

still stronger through the presence of lymph follicles and powerful layers of smooth-muscle fibres. Further products of the intestinal tract, *especially the large glands of the abdominal cavity,* I have never observed."

Since Wilms so easily adopts these glandular structures as intestine because they are surrounded by muscle fibres, it is interesting to observe what he says concerning striated muscle: "In contrast to the frequent occurrence of smooth-muscle fibres is *the absence of striated muscle.* I have found striated fibres in none of my specimens, in spite of the closest examination. The only authors who mention striated muscle in dermoid cysts are Marchand and Velits. I am not able to give any definite reason for this absence. It is only a pure hypothesis on my part when I say that perhaps *the inability to exercise movement may cause this poor development of striations in the malformation*" (!!).

Since Wilms finds in two cases hair within the brain, he is compelled "with Hildebrandt to show that it is simply a perforation of hair through the organs of the malformation. That a development of these hairs occurred in the brain itself is not to be thought of" (?). Since we have found in our specimens hair in various parts of the prominence and likewise hair follicles, this fact speaks against the regular arrangement which Wilms always expects, but which, however, was not found in all his cases. Concerning one case he says: "We realize that the development of intestine usually occurs toward the lumen of the cyst, yet here a dorsal and ventral surface cannot be distinguished. The difficulty is to explain why the skin, *which is beyond doubt scalp,* is not situated dorsal to the brain instead of near the entoderm. I cannot discuss the various mechanical disturbances of growth which may have taken part in forming this displacement."

Wilms considers the dermoid malformation to be "a decided parasite, which as such uses the maternal organism to regulate its own circulation and nutrition and to excrete and do away with its own injurious products. Probably the absence of certain organs of the malformation stands in relation to its parasitical nature. Since its circulation and nutrition and the excretion of the used-up products is accomplished by the mother, this probably explains *the regular absence of certain organs, such as the kidney, the liver, etc.*"

Finally Wilms says:

"In addition to the disturbance in growth due to the small amount of space within the ovary, and in addition *to the*

in the ovarian parasites is regulated by the maternal organism. Yet the malformation itself furnishes a vessel system and is concerned, under certain conditions, in the distribution of blood.”	connection of a dermoid cyst as a tumor is the same as in the case of any mixed tumor.
10. Since not alone the circulation, but also the nutrition and excretion of used-up products, is regulated by the mother, this explains *the constant absence of certain organs, such as liver and kidney.*”	A dermoid cyst of the ovary is no more able to form a liver and a kidney than dermoid cysts in other parts of the body. It needs for the excretion of used-up products a liver and a kidney just as little as any other dermoid cyst or as a fibroma or a chondroma.
11. “The dermoid malformations of the ovary are therefore to be considered as parasitical fetus which, as such, can be characterized as an independent group by the name ‘rudimentary ovarian parasites.’”	The dermoid cysts of the ovary differ from others only through their more complicated structure and through the more frequent occurrence of the dermoid prominence. They have absolutely nothing in common with a fetus, form no independent group, and are only to be divided into cystic and solid dermoids.

The dermoids of the testicle are distinguished from those of the ovary in that the ectoderm is less prominent, but aside from this they show so distinctly the character of mixed tumors that this cannot be doubted. And the reason for this difference we have already discussed, though a positive statement is naturally difficult. That the dermoid cysts of the ovary occur congenitally as well as in childhood, that they are often bilateral and often combined with a cystadenoma in the same or in the other ovary, and, further, the fact that they contain only ectoderm and mesoderm products and may occur in the ligamentum latum without involvement of the ovary, are all conditions which can only be explained on the theory of the displacement of cells; therefore they are nothing but mixed tumors, and because of the presence of skin and hair are called “dermoid.”

In dermoid cysts of the ovary we have a cyst filled with cheesy matter and hair whose wall, as a rule, shows a prominence at one point. The base of this prominence is formed by ovarian tissue, and this area, even if the thickness of the prominence be not added, is much greater in thickness than the rest of the cyst wall. The prominence is covered with squamous epithelium often evidencing depressions. The nearer the squamous epithelium approaches the base of the prominence, the greater is the tendency of the squamous epithelium to change into cylindrical epithelium, ciliated epithelium, or epithelium with beaker cells. Beyond the base these various forms of epithelia pass over into a form of granulation tissue which lines the rest of the cyst wall. Often this tissue consists of large cells with numerous nuclei, and by direct examination it may be seen to go over into squamous epithelium or to lie immediately beneath squamous epithelium. This tissue shows various transition forms, so that at times it represents an acinous glandular tissue in its earlier stage, from which later glandular formations develop. The same areas are found in the dermoid prominence itself.

Directly under the squamous epithelium of the prominence lie numerous sweat glands, sebaceous glands, etc. In the prominence are found muscle fibres and muscle bundles, which latter are frequently grouped about growing cysts. Bone and cartilage are present in plenty, and the former show microscopically the structure of a tooth in numerous cases. Fat tissue, connective tissue, myxomatous tissue furnish the other elements of the prominence.

As regards glandular structures we have various forms: Glands, in all stages of development, which are really like salivary glands and occur in scattered groups. They may form a large mass whose excretory duct opens upon the surface. Other glandular structures are lined with a high cylindrical epithelium, with a nucleus at the base, contain numerous beaker cells, and frequently are arranged so that they resemble the glands of the stomach or intestine or the crypts of Lieberkühn. These are simply more complicated forms of those already mentioned. Other glandular structures, especially those containing beaker cells, have as contents a reticular tissue in which lie large round or spindle-shaped cells with very large nuclei, a form of myxomatous tissue. The other structures furnish cysts lined with a stratified cylindrical epithelium, others show papillary excrescences, and still others are lined with stratified ciliated epithelium. That all these glandular structures and cysts are of common origin is proven by the fact that from all of them develop structures which without doubt may be classified as very much like salivary glands. The probable course of origin of these various structures are the tubules of the Wolffian body, for the various forms of ovarian cysts show the same structure.

The already mentioned depressions of the surface squamous epithelium show almost the same forms of epithelium, *i.e.*, squamous epithelium goes over to cylindrical and then into the so-called "excrescences," then into ciliated epithelium, into cylindrical epithelium with beaker cells, and again into ciliated epithelium; etc., in all possible variations.

In the prominence are frequently found large areas of a connective-tissue substance containing numerous small round nuclei. In this tissue, as in other tissues, may be found glandular structures lined with cylindrical epithelium. Wilms calls this tissue "glia" because corpora amylacea are present, although it does not take on the stain of Weigert. As a matter of fact, we can only say that we are dealing with a round-celled embryonal tissue which resembles glia tissue, and it is always found directly under the surface epithelium of the prominence or directly under the sebaceous glands. Specific nerve elements are not found.

In the prominences pigment is a frequent occurrence. 1. The hairs contain numerous pigment granules. 2. Pigment may lie scattered everywhere as dark spots. 3. The previously mentioned acinous glandular tissue is often richly pigmented. 4. The spinal ganglia may contain pigment cells. 5. Cysts lined with a pigmented epithelium have also been described. 6. The cells of these various combinations may lie so close together that they take on a polyhedral shape showing no intercellular substance. This pigmentation is characteristic of ectodermal products.

In Fig. 79 it is seen that the ciliated epithelium at the base of the prominence stands in relation to glandular structures. So soon as they are filled with a secretion the epithelium becomes flattened. Here are also cysts which are lined with a high epithelium. These often show excrescences covered with epithelium, so that there is a relation between these structures in the ovarian tissue and others situated in the dermoid prominence. As a matter of fact, almost all the dermoid prominences show such glandular formations in the ovarian base also. The base of the prominence is naturally formed of ovarian tissue only in those dermoid cysts which occur in the ovary, and not in such as occur in the ligament. The prominence is well developed when the bone pieces take on a strong growth and project beyond the surface. These bone pieces may take on the most varying irregular forms, and often contain teeth. The entire structure of the tumor furnishes a complex histological picture of the various products which are furnished by ectoderm and mesoderm. *In these tumors all the glandular structures are of ectodermal origin.* The various tissues have no regular arrangement and represent only tissues, for in no case is an organ present. If the tissue which Wilms calls "glia tissue" is to be viewed as such, it must be considered just as squamous epithelium, etc., only as a product of ectoderm. The same formations are found in dermoids in other parts of the body, but the development of the genitalia being a complex process, and the cells which are displaced being removed at a very early period and growing in the pelvis without obstruction, we find in the dermoid cysts of the ovary, as a rule, a very complicated structure. It is not to be doubted that they develop through the action of the Wolffian body and the Wolffian duct, as do the larger number of cysts of the ovary and ligamentum latum. In this way the dermoids in all parts of the body are the result of displaced cells, which seems more probable than two entirely different explanations for tumors of the same structure but occurring in different parts of the body. It is to be hoped that through further investigations our theory as to the origin of dermoid cysts may find support.

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LITERATURE.

Abel: Mikroskopische Technik, etc. II. Aufl. Berlin, August Hirschwald, 1900.

Augagneur: Tumeurs du mésentère. Thèse de Paris, 1886.

Ahlfeld: Die Missbildungen des Menschen. Leipzig, 1880, 1882.

Baumgarten: Virch. Arch., Bd. 107, S. 515.

Bardenheuer: Der extraperitoneale Explorativschnitt, S. 680.

Beck: Zeitschr. f. Heilkunde, Bd. 4, 1883.

Bonfigli: Ref. Schmidt's Jahrb., clxx., 1876, S. 180.

Biernacki: Inaug.-Dissert., Berlin, 1897. **Sänger**: Arch. für G., Bd. 37.

Breslau: Virch. Arch., Bd. 30, 1864.

Burckard: Virch Arch., Bd. 144, 1896.

Böttlin: Virch. Arch., Bd. 115.

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